D.C. DEPARTMENT OF HEALTH
Environmental Health Administration
Bureau of Environmental Quality
Water Quality Division

DISTRICT OF COLUMBIA

FINAL

TOTAL MAXIMUM DAILY LOADS

FOR

ORGANICS AND METALS

IN

BROAD BRANCH, DUMBARTON OAKS, FENWICK BRANCH, KLINGLE VALLEY CREEK, LUZON BRANCH, MELVIN HAZEN VALLEY BRANCH, NORMANSTONE CREEK, PINEHURST BRANCH, PINEY BRANCH, PORTAL BRANCH, AND SOAPSTONE CREEK

FEBRUARY 2004

Government of the
District of Columbia
Anthony A. Williams, Mayor

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DEPARTMENT OF HEALTH
ENVIRONMENTAL HEALTH ADMINISTRATION
BUREAU OF ENVIRONMENTAL QUALITY
WATER QUALITY DIVISION

FEBRUARY 2004

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1. Introduction

1.1. TMDL Definition and Regulatory Information

Section 303(d) (1)(A) of the Federal Clean Water Act (CWA) states:

> *Each state shall identify those waters within its boundaries for which the effluent limitations required by section 301(b) (1)(A) and section 301(b)(1)(B) are not stringent enough to implement any water quality standards applicable to such waters. The State shall establish a priority ranking for such waters taking into account the severity of the pollution and the uses to be made of such waters.*

Further, Section 303(d) (1)(C) states:

> *Each state shall establish for the waters identified in paragraph (1)(A) of this subsection, and in accordance with the priority ranking, the total maximum daily load, for those pollutants which the Administrator identifies under section 304(a)(2) as suitable for such calculations. Such load shall be established at a level necessary to implement the applicable water quality standards with seasonal variations and a margin of safety which takes into account any lack of knowledge concerning the relationship between effluent limitations and water quality.*

Section 303(d) of the Clean Water Act and EPA's Water Quality Planning and Management Regulations (40 CFR Part 130) require states to develop Total Maximum Daily Loads (TMDLs) for waterbodies, which are exceeding water quality standards.

In 1996, the District of Columbia (DC), developed a list of impaired waters that did not or were not expected to meet water quality standards as required by Section 303(d)(1)(A). This list, submitted to the Environmental Protection Agency every two years, is known as the Section 303(d) list. This list of impaired waters was revised in 1998 and also in 2002 based on additional water quality monitoring data. EPA, subsequently, approved each list. The Section 303(d) list of impaired waters contains a priority list of those waters that are the most polluted. This priority listing is used to determine which waterbodies are in critical need of immediate attention. For each of the listed waters, states are required to develop a Total Maximum Daily Load (TMDL), which establishes the maximum amount of a pollutant that a waterbody can receive without violating water quality standards and allocates that load to all significant sources. Pollutants above the allocated loads must be eliminated. By following the TMDL process, states can establish water-quality based controls to reduce pollution from both point and nonpoint sources to restore and maintain the quality of their water resources.

1.2. Rock Creek Watershed Location

The Rock Creek watershed comprises approximately 76 square miles, with 20% of the drainage area within the District of Columbia and the remaining 80% within Montgomery County, Maryland. Rock Creek stretches 33miles, but in the District of Columbia it only runs 9.3 miles. This creek is predominantly within the Piedmont province, with only a small percentage of the creek being tidally influenced. The head of tide is approximately where Pennsylvania Avenue crosses the waterway. Figure 1-1 shows the Rock Creek watershed in the District of Columbia.

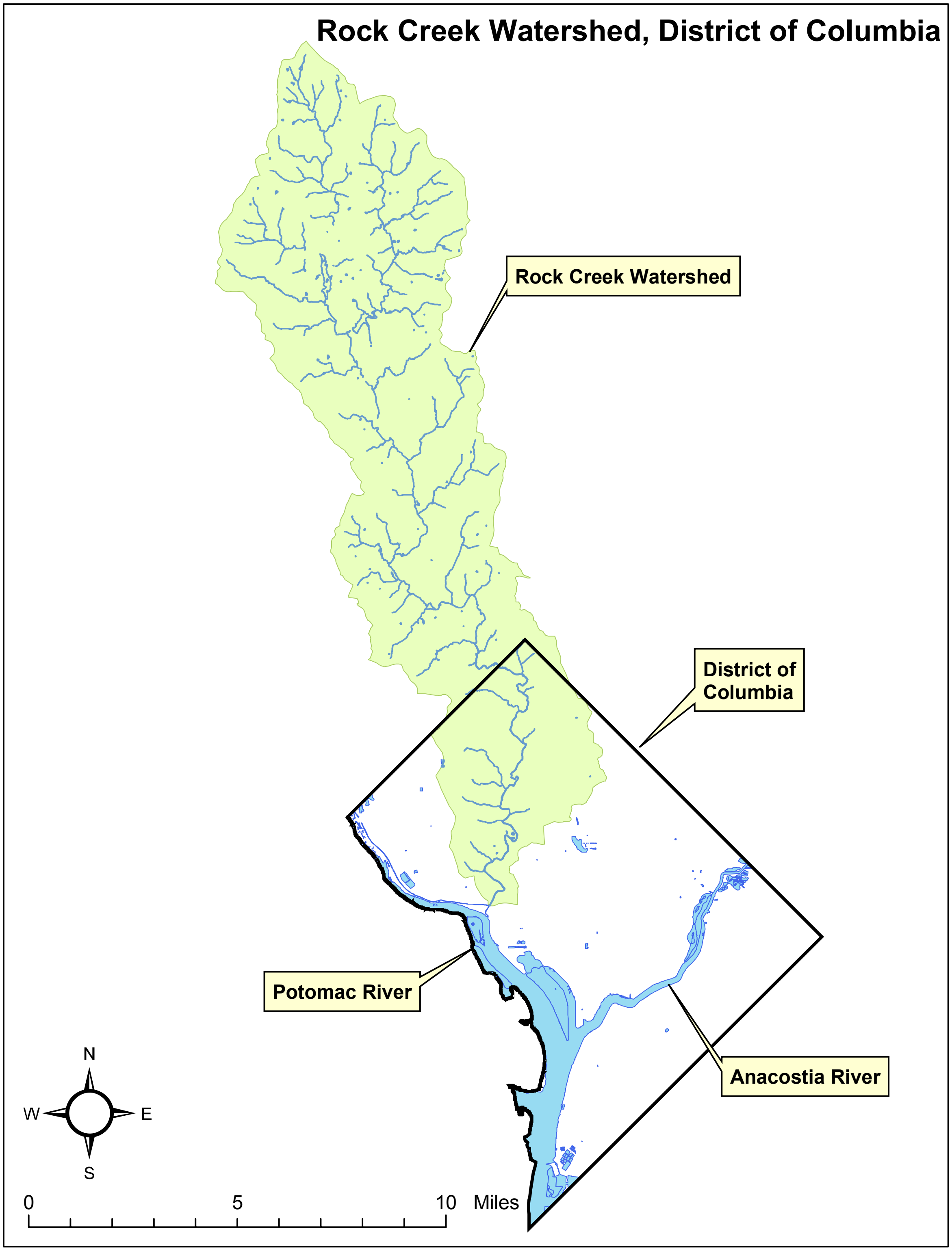

Figure 1-1: Rock Creek Watershed

1.3. Impairment Listing

As required by the Federal Clean Water Act, the District of Columbia prepared 303(d) list of water bodies for which the effluent limitations required by section 301(b)(1)(A) and section 301(b)(1)(B) are not stringent enough to meet the applicable Water Quality Standards (WQS). The list was prepared in 1996, 1998 and again in 2002. Depending on yearly monitoring of water bodies, the District has revised the pollutants of concerns and ranking of the water bodies. Figure 1-2 shows impaired Rock creek tributaries according to the 2002 303(d) list.

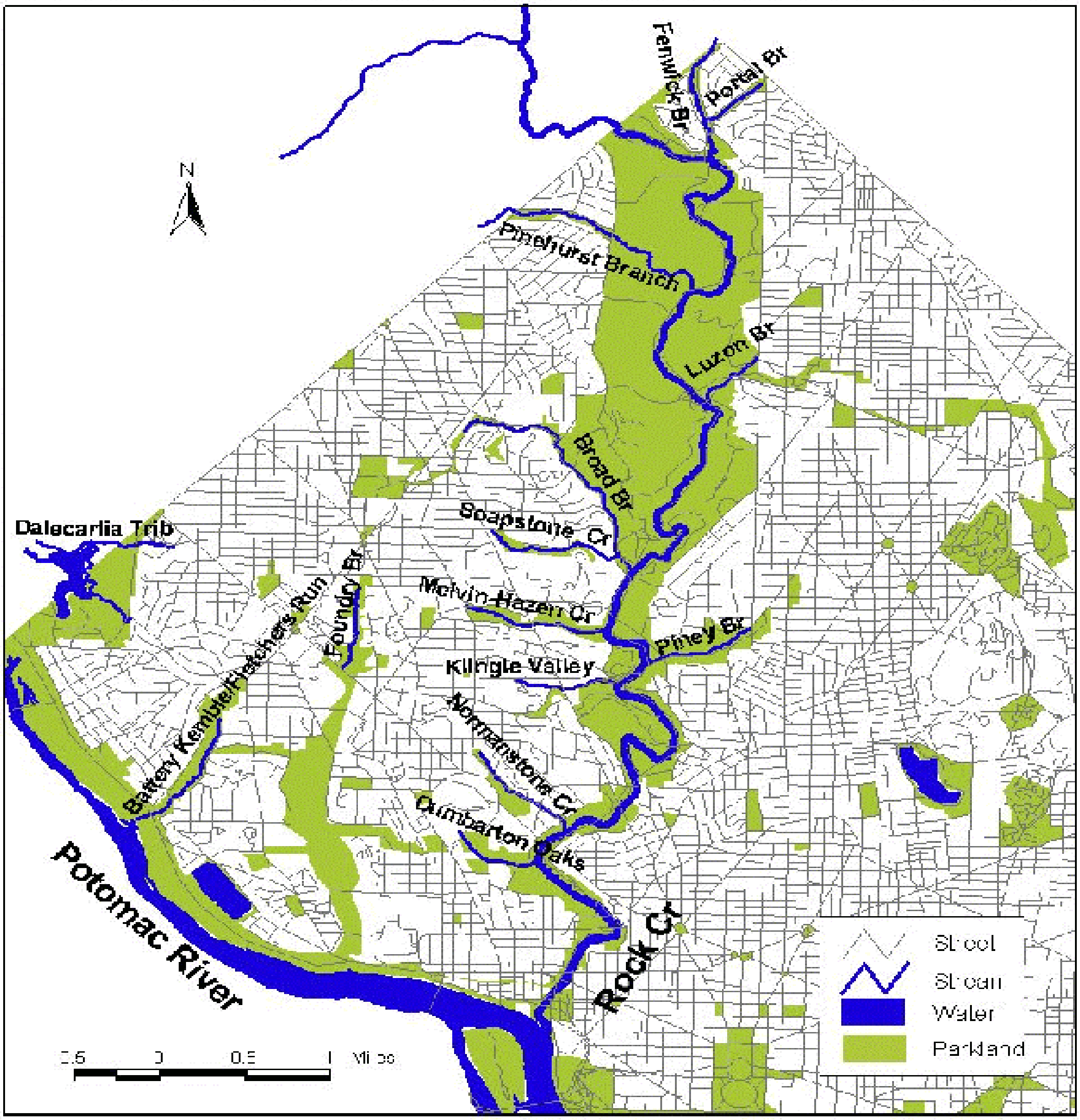

Figure 1-2: Rock Creek Tributaries

Table 1-1, Table 1-2 and Table 1-3 show 303(d) lists of Rock Creek tributaries for 1996, 1998 and 2002, respectively.

Table 1-1: 1996 Section 303(d) Listing Information

S. No	Waterbody	Pollutant of Concern	Priority Ranking	Action Needed
1.	Broad Branch	Organics and Toxics	Low	Control nonpoint source (NPS) pollution
2.	Dumbarton Oaks	Organics and Toxics	Low	Control NPS pollution
3.	Fenwick Branch	Organics and Toxics	Low	Control NPS pollution
4.	Klingle Valley Creek	Organics and Toxics	Low	Control CSO and NPS pollution
5.	Luzon Branch	Organics and Toxics	Low	Control CSO and NPS pollution
6.	Melvin Hazel Valley Branch	Organics	Low	Control NPS pollution
7.	Normanstone Creek	Organics, Toxics, and Nutrients	Low	Control NPS pollution
8.	Pinehurst Branch	Organics and Bacteria	Low	Control NPS pollution
9.	Piney Branch	Organics and Metals	Low	Control CSO and NPS pollution
10.	Portal Branch	Organics and Toxics	Low	Control NPS pollution
11.	Soapstone Creek	Organics and Toxics	Low	Control NPS pollution

Table 1-2: 1998 Section 303(d) Listing Information

S. No	Waterbody	Pollutant of Concern	Priority Ranking	Action Needed
1.	Broad Branch	Organics	Low	Control nonpoint source (NPS) pollution
2.	Dumbarton Oaks	Organics	Low	Control NPS pollution
3.	Fenwick Branch	Organics	Low	Control NPS pollution
4.	Klingle Valley Creek	Organics	Low	Control CSO and NPS pollution
5.	Luzon Branch	Organics	Low	Control CSO and NPS pollution
6.	Melvin Hazel Valley Branch	Organics	Low	Control NPS pollution

S. No	Waterbody	Pollutant of Concern	Priority Ranking	Action Needed
7.	Normanstone Creek	Organics	Low	Control NPS pollution
8.	Pinehurst Branch	Organics	Low	Control NPS pollution
9.	Piney Branch	Organics	Low	Control CSO and NPS pollution
10.	Portal Branch	Organics	Low	Control Point Source and NPS pollution
11.	Soapstone Creek	Organics	Low	Control NPS pollution

Table 1-3: 2002 Section 303(d) Listing Information

S. No	Waterbody	Pollutant of Concern	Priority Ranking	Action Needed
1.	Broad Branch	Fecal Coliform	Medium	Control nonpoint source (NPS) pollution
2.	Dumbarton Oaks	Fecal Coliform	Low	Control NPS pollution
3.	Fenwick Branch	Fecal Coliform	Low	Control NPS pollution
4.	Klingle Valley Creek	Fecal Coliform	Low	Control CSO and NPS pollution
5.	Luzon Branch	Fecal Coliform	Medium	Control CSO and NPS pollution
6.	Melvin Hazel Valley Branch	Fecal Coliform	Low	Control NPS pollution
7.	Normanstone Creek	Fecal Coliform	Low	Control NPS pollution
8.	Pinehurst Branch	Fecal Coliform	Medium	Control NPS pollution
9.	Piney Branch	Fecal Coliform	Low	Control CSO and NPS pollution
10.	Portal Branch	Fecal Coliform	Medium	Control Point Source and NPS pollution
11.	Soapstone Creek	Fecal Coliform	Medium	Control NPS pollution

2.0 Chemical of Concern, Beneficial Uses and Applicable Water Quality Standards

2.1 Chemicals of Concern

Because of general lack of data in the District's tributaries, the list of chemicals of concern for this TMDL were determined from data derived from fish tissue[1] and sediment[3] analysis in the Anacostia River. Fish tissue was harvested and analyzed for the list of suspected contaminants.

The contaminants of concern that were discovered above the allowed concentration were identified and were included in this TMDL. Sediment samples were also collected and analyzed for the contaminants of concern. Those that indicated high levels of exceedance above the screening criteria were identified as contaminants of concern and included in the TMDL. Table 2-1 represents the results of this assessment.

A data assessment study has also recently been conducted to determine potential chemicals of concerns for main-stem Rock Creek Toxics TMDL (LTI, 2003). This included analysis of several previous studies in the Rock Creek watershed, including the DC Water and Sewer Authority (DCWASA) Combined Sewer Overflow (CSO) Long Term Control Plan (LTCP) study conducted in 1999-2000 period, the USGS water quality baseline study for Rock Creek in 1999-2000 period, the 1995 Storm Water Permit Application, Bioassessments of Rock Creek, and the ambient DC water quality monitoring program. Based on the study, a group of most likely and probable likely chemicals of concerns have been identified, with the most likely chemicals being cadmium, copper, lead, mercury, and zinc; and the probable likely chemicals being chlordane, DDT, endosulfan, heptachlor epoxide, hexachlorobenzene, total PAHs, and total PCBs. Given the very limited amount of data available in Rock Creek watershed, chemicals listed in Table 2-1 are considered to encompass the toxics in different Rock Creek tributaries.

Table 2-1: Fish Tissue and Sediment Data Exceeding Screening Values

Organic/Metal Exceedance	Anacostia Fish tissue Data[1] (ppm)	EPA Screening Value[2] (ppm)	Anacostia Sediment Data[3] (ppm dw)	Sediment Screening value[4] (ppm dw)
Arsenic	0.026	0.026	N/A	N/A
Copper	N/A	N/A	312.5	31.6
Lead	N/A	N/A	586.54	35.8
Zinc	N/A	N/A	1,457.290	121
Chlordane	0.338	0.114	0.1699	0.00324
DDT	0.375	0.117	0.3194	0.00528
Dieldrin	0.0315	0.0025	N/A	N/A
Heptachlor Epoxide	0.0080	0.00439	NA	NA
Total PAHs	0.151	0.00547	97.878	1.61
Total PCBs	2.49	0.020	1.629	0.0598

Notes: N/A Data not available.

1. U.S. FWS. 2001. Analysis of Contaminant Concentrations in Fish Tissue Collected from the Waters of the District of Columbia. Final Report. Publication number CBFO-C01-01, Chesapeake Bay Field Office, Annapolis, MD.
2. U.S. EPA 2000. Guidance for Assessing Chemical Contaminant Data for Use in Fish Advisories, Volume 1, Fish Sampling and Analysis, Third edition. EPA 823-B-00-007, Office of Water, Washington D.C.
3. Academy of Natural Sciences, 2000, Data Assessment Report Anacostia River Sediments Patrick Center for Environmental Research, The Academy of Natural Sciences of Philadelphia, KQS Report Number 134-01R01. Appendix II. September 2000.

4. MacDonald, D.D., C.G. Ingersoll and T.A. Berger. 2000. Development and Evaluation of Consensus-Based Sediment Quality Guidelines for Freshwater Ecosystems. *Arch. Environ. Contam. Toxicol.* 29-31.

2.2 Designated Beneficial Uses

Categories of DC surface water beneficial uses and water quality standards are contained in District of Columbia Water Quality Standards, Title 21 of the District of Columbia Municipal Regulations, Chapter 11 (DC WQS, Effective January 24, 2003). Section 1101.1 states:

> *For the purposes of water quality standards, the surface waters of the District shall be classified on the basis of their (i) current uses, and (ii) future uses to which the waters will be restored.*

The categories of beneficial uses for Rock Creek and its tributaries are as follows:

Class A - primary contact recreation,
Class B - secondary contact recreation and aesthetic enjoyment,
Class C - protection and propagation of fish, shellfish, and wildlife,
Class D - protection of human health related to consumption of fish and shellfish, and;
Class E - navigation.

2.3 Applicable Water Quality Standards

2.3.1 Narrative Criteria

The District of Columbia's Water Quality Standards include narrative and numeric criteria that were written to protect existing and designated uses.

Section 1104.1 states several narrative criteria designed to protect the existing and designated uses:

> *The surface waters of the District shall be free from substances attributable to point or nonpoint sources discharged in amounts that do any one of the following:*
>
> 1. *Settle to form objectionable deposits;*
> 2. *Float as debris, scum, oil, or other matter to form nuisances;*
> 3. *Produce objectionable odor, color, taste, or turbidity;*
> 4. *Cause injury to, are toxic to or produce adverse physiological or behavioral changes in humans, plants, or animals;*
> 5. *Produce undesirable or nuisance aquatic life or result in the dominance of nuisance species; or*
> 6. *Impair the biological community which naturally occurs in the waters or depends on the waters for their survival and propagation.*

2.3.2 Numerical Criteria

2.3.2.1 Metals Numerical Criteria

Table 2-2: Dissolved Metals Numerical Criteria

Constituent – Metals[1]	Criteria for Classes (ug/L)		
	C[2]		D
	CCC Four Day Average	CMC One Hour Average	30 Day Average
Arsenic	150	340	0.14
Copper[3]	12.31	18.61	N/A
Lead[4]	2.79	71.63	N/A
Zinc[5]	113.29	124.07	N/A

Notes:

1. D.C. Water Quality Standards, Effective January 24, 2003, Table 2. The criteria for the hardness dependant constituents (Copper, Lead and Zinc) were calculated utilizing the applicable formulas in the Notes for Table 2. To calculate the dissolved criteria, the formula results were multiplied by their respective EPA Conversion Factor. The respective EPA Conversions Factors were derived in accordance with subsection 1105.10 from 60 Fed. Ref. 22,231 (1995).
2. The Class C Criteria Maximum Concentration (CMC) and Criteria Continuous Concentration (CCC) standards were computed from the published District of Columbia standards (listed below under note 3, 4, and 5) assuming a hardness of 110 mg/L as $CaCO_3$, the 50 percentile hardness value for data in Rock Creek from 1984-2000.
3. Copper is expressed as a function of hardness calculated using the following formula:
   $CCC = e^{(0.8545[\ln(hardness)]-1.465)} \times 0.96$; $CMC = e^{(0.9422[\ln(hardness)]-1.464)} \times 0.96$
4. Lead is expressed as a function of hardness calculated using the following formula:
   $CCC = [e^{(1.2730[\ln(hardness)]-4.705)}] \times [1.46203-[(\ln(hardness)(0.145712)]]$; and
   $CMC =[e^{(1.2730[\ln(hardness)]-1.460)}] \times [1.46203-[(\ln(hardness)(0.145712)]]$
5. Zinc is expressed as a function of hardness calculated using the following formula:
   $CCC = [e^{(0.8473[\ln(hardness)]+0.7614)}] \times 0.986$; $CMC = [e^{(0.8473[\ln(hardness)]+0.8604)}] \times 0.978$

2.3.2.2 Organics Numerical Criteria

Table 2-3: WQS Section 1104.7 Table 3 Organics Numerical Criteria

Constituent – Organics[1]	Criteria for Classes (ug/L)		
	C		D
	CCC Four Day Average	CMC One Hour Average	30 Day Average
Chlordane	0.004	2.4	0.00059
DDE	0.001	1.1	0.00059
DDD	0.001	1.1	0.00059
DDT	0.001	1.1	0.00059
Dieldrin	0.0019	2.5	0.00014
Heptachlor Epoxide	0.0038	0.52	0.00011
PAH 1[2]	50	N/A	14000
PAH 2[3]	400	N/A	0.031
PAH 3[4]	N/A	N/A	0.031
Total PCBs	0.014	N/A	0.000045

Notes:

1. WQS for PAH1, 2 and 3 were based on a conservative assumption that applicable water quality standards are the most stringent standard for a single PAH in the group. For example, the Class D water quality standard for fluoranthene, pyrene, benz[a]anthracene, and chrysene are 370, 11000, 0.031, and 0.031 ug/l,

respectively. Therefore the most stringent of the individual standards, 0.031 ug/l is given in Table 2-3 as the Class D standard for PAH2.

2. PAH1, is the sum of six 2 and 3-ring PAHs, naphthalene, 2-methyl napthalene, acenapthylene, acenapthene, fluorene, and phenanthrene.
3. PAH2, consists of the four 4-ring PAHs, fluoranthene, pyrene, benz[a]anthracene, and chrysene.
4. PAH3, consists of the six 5 and 6-ring PAHS, benzo[k]fluoranthene, benzo[a]pyrene, perylene, indeno[1,2,3-c,d]pyrene, benzo[g,h,i]perylene, and dibenz[a,h+ac]anthracene.

2.4 TMDL Endpoint

Section 2.3 describes applicable D.C. water quality standards for this TMDL analysis. The analysis used the numeric criteria to achieve load allocations for the tributaries.

3.0 Watershed Characterization

3.1 Rock Creek Watershed

Land use in Rock Creek is predominantly residential, commercial, and park land/open space. Rock Creek Park is one of the oldest city parks in the nation and is host to many recreation activities, including biking, jogging, golf, and horseback riding. The United States Park Police maintain two horse stables within the Park and a private stable is located in Montgomery County just upstream from the District border. The park and watershed are also home to the Smithsonian Institution's National Zoological Park, boasting a wide array of exotic and domestic fauna.

Rock Creek is fairly shallow and swift, as it lies mainly along the fall line between the Piedmont and Coastal Plain provinces. The low volume in the creek results in poor dilution potential, but the rapid flow rates allow for good flushing rates. The average flow rate in Rock Creek is approximately 63.7 cubic feet per second. Watershed characteristics of Rock Creek tributaries are described in the following. Appendix A shows maps for each of the tributaries listed below.

3.1.1 Broad Branch

Broad Branch is about a 2-mile long western tributary of Rock Creek. It is joined by Soapstone Creek about 800 feet before it discharges into Rock Creek. Broad Branch begins near Nebraska and Connecticut Avenues. For half of its length, Broad Branch is bordered on one side by National Park Service parkland and on the other side by Broad Branch Road which directly abuts it. The lower reach of the stream travels through Rock Creek Park and is bordered by an approximately 200-foot buffer of tree and shrubs. The Broad Branch watershed encompasses 1129 acres. Fifteen percent of the watershed is parkland, while the remaining area is residential and retail commercial. The stream is about 25 feet wide with a very shallow depth of approximately 3 inches and a flow of approximately 7.8 cubic feet per second.

3.1.2 Dumbarton Oaks

Dumbarton Oaks is a minor western tributary whose confluence with Rock Creek is about 100 yards south of Massachusetts Avenue over Rock Creek. The Dumbarton Oaks watershed is approximately 168 acres and drains mostly National Park Service parkland, including about a quarter of the grounds of the US Naval Observatory and Dumbarton Oaks Gardens. Approximately two-thirds of the watershed is landscaped or forested parkland, with the remainder area as residential. Dumbarton Oaks is a little more than a half-mile long and is buffered with varying widths of landscaped parkland as it flows eastward to Rock Creek. It is very steep, dropping 200 feet from the head of its watershed to its mouth near Rock Creek. The channel is about 22 feet wide with an estimated flow of 0.3 cubic feet per second.

3.1.3 Fenwick Branch

Fenwick Branch is a second order eastern tributary of Rock Creek originating in Maryland just outside the Northeastern D.C. boarder. Fenwick Branch's watershed measures approximately 612 acres, but about 205 acres are within District boundaries, the rest being in Montgomery County, Maryland. The watershed is primarily urbanized, including residential areas inside the District and some commercial and light industrial in Maryland. The tributary runs a little more than half a mile before joining Portal Branch, approximately 120 feet north of its confluence with Rock Creek. Throughout the length of the stream it is buffered by approximately 100 feet of forested parkland on both sides. The stream channel is about 6 feet wide with an average depth of about 3 inches and a flow of approximately 2.0 cubic feet per second.

3.1.4 Klingle Valley Creek

Klingle Valley tributary flows through a residential area and discharges into Rock Creek from the west near the Porter Street Bridge. The stream's reach parallels the south side of Klingle road. The watershed comprises about 354 acres and is primarily residential. A wooded buffer of a few hundred feet covers one side of the stream. Klingle Valley Tributary is an approximately half a mile long stream that falls at a grade of about 5% from its headwaters to its confluence with Rock Creek. The stream channel is about 30 feet wide with an average depth of about 3.5 inches and a flow of approximately 0.83 cubic feet per second.

3.1.5 Luzon Branch

Luzon Branch is an eastern tributary of Rock Creek. It travels roughly half a mile southwest and empties into Rock Creek at Joyce Road. The stream's watershed measures about 648 acres, with almost 90 percent of the watershed is residential and light commercial, and the rest is parkland. The stream is buffered by 100-1000 foot of parkland. Luzon Branch is approximately 26 feet wide, and has a depth of about 7 inches and a flow of about 0.8 cubic feet per second.

3.1.6 Melvin Hazen Valley Branch

Melvin Hazen is a second order tributary of Rock Creek. It originates near 34th street and Tilden Street, NW and flows approximately 600 feet eastward before empting into Rock Creek. The Melvin Hazen watershed covers 184 acres, with more than two-thirds of the watershed is residential and commercial. The lower segment of the watershed is parkland. Melvin Hazen stretches approximately 4,500 feet to its mouth at Rock Creek, and buffered on both sides by a several hundred foot wide forested parkland. The stream is about 11 feet wide, 6 inches deep and has a flow of approximately 0.9 cubic feet per second.

3.1.7 Normanstone Creek

Normanstone Creek is a first order western tributary of Rock Creek and originates from a storm drain near Garfield Avenue and 33rd Street, NW. The stream travels parallel to Normanstone Parkway three quarters of a mile southeast to its confluence with Rock Creek, about 1000 ft northeast of the Massachusetts Avenue bridge. The watershed covers 249 acres area and includes most of the grounds of the National Cathedral, part of U.S. Naval Observatory and parts of Cleveland and Woodley Park. Most of the acreage is residential and light commercial (retail) with about 10% forested parkland along the stream reach. Both sides of the stream are buffered by a 100-1000 feet strip of forested parkland. Normanstone Creek is approximately 12 feet wide and has a shallow depth of 7 inches. The channel flow is estimated to be around 0.63 cubic feet per second.

3.1.8 Pinehurst Branch

Pinehurst Branch originates at the DC / Maryland state line in Chevy Chase Manor, Maryland. Pinehurst travels about 1.3 miles east-southeast to its confluence with Rock Creek. The 619-acre Pinehurst watershed includes mainly urban land uses, with 70 percent low-medium density residential and commercial, and the remaining area being parklands. About 70 percent of the watershed lies in the District, with the remaining in Montgomery County, Maryland. The average gradient of the stream is approximately 2 percent over its entire length. Pinehurst Branch is shallow with a depth of about 5 inches and a flow of approximately 1-2 cubic feet per second. Evidence of the stream topping its banks suggests high flows are common and easily top their relatively low banks.

3.1.9 Piney Branch

Piney Branch runs approximately three-quarters of a mile through a strip of forested parkland about 1,000 yards wide before it enters Rock Creek from the East above the National Zoo. The Piney Branch watershed is the largest of all the District Rock Creek tributaries. The watershed comprises 2,500 acres and is completely within the District of Columbia. The large size of the watershed compared to such a short stream length can be attributed to the extensive system of combined sewer and storm drains that underlie the city in this area. The surface stream portion of the watershed is surrounded by predominantly forested parkland, and comprises about 5 percent of the entire watershed. The rest of the watershed is primarily urban residential and some light commercial. Piney Branch is approximately 12 feet wide and has a depth of about 4 inches. The flow in the channel is estimated to be about 1.8 cubic feet per second.

3.1.10 Portal Branch

Portal Branch is an eastern tributary of Rock Creek near the northern corner of D.C., and joins Fenwick Branch about 120 ft. north of the Fenwick Branch's confluence with Rock Creek. The surface portion of the stream is less than half a mile long and is completely contained in the District. The watershed measures 213 acres, of which 75 acres lie within the District. The watershed in the District is mainly low-medium density residential and parklands, while in Montgomery County mostly commercial/industrial uses dominate the watershed. The stream is buffered by 100 feet or less of parkland. Portal Branch stretches about 2220 feet and has an average width of 10 feet. It is a shallow stream with a depth of 3-4 inches and a flow of approximately 1.1 cubic feet per second.

3.1.11 Soapstone Creek

Soapstone Creek is a tributary of Broad Branch. Soapstone joins Broad Branch just before Broad Branch's confluence with Rock Creek. The watershed covers 520 acres and is mostly urban, with approximately 15% parkland and forest in the lower reaches of the creek. The northern quarter of the urban watershed is densely populated residential property. The southwestern quarter of the watershed is much less densely populated residential and commercial property. Soapstone Creek runs about 0.9 miles through a steep-sided heavily wooded valley about 500 yards wide. The average channel width is approximately 15 feet and the flow rate is estimated to be about 3 cubic feet per second.

Stream Flow Characteristics of Rock Creek Tributaries are summarized below:

Table 3-1: Rock Creek Tributaries Stream Flow Data

Waterbody	**Area (acres)**	**Avg. Width (feet)**	**Estimated Flow (cubic feet per second)**
Broad Branch	1129	25	7.80
Dumbarton Oaks	168	22	0.30
Fenwick Branch	612	6	2.00
Klingle Valley Creek	354	30	0.83
Luzon Branch	648	26	0.80
Melvin Hazen Valley Branch	184	11	0.90
Normanstone Creek	249	12	0.63
Pinehurst Branch	619	NA	1.50
Piney Branch	2500	12	1.80
Portal Branch	213	10	1.10
Soapstone Creek	520	15	3.00

NA – not available

4.0 Source Assessment

Within the District of Columbia, there are three different networks for conveying wastewater. Originally, a combined sewer system was installed that collected both sanitary waste and storm water and transported the combined flow to the wastewater treatment plant. When storm water caused the combined flow to exceed the pipe capacity leading to the treatment plant, the excess flow was discharged, untreated, through Combined Sewer Overflow (CSO) outfalls to the river.

In the upper two thirds of the drainage area, a separate sanitary sewer system and a storm sewer system were constructed. A separate sanitary sewer line has no storm water inlets to the system and it flows directly to the wastewater treatment facility. Storm water pipes collect storm water from the streets and parking lots and are discharged to nearby rivers and streams.

4.1 Assessment of Nonpoint Sources

A large portion of Rock Creek watershed is served by the separate storm sewer system. In addition, direct runoffs from parklands flanking the water bodies and not serviced by storm water sewers also occur along Rock Creek and its tributaries. Therefore, during wet weather events, there is a combination of direct storm water runoff and storm water being carried by pipes to receiving water bodies. Historically considered nonpoint source, storm water runoff discharged from separate storm water systems (SSWS) are permitted under the National Pollution Discharge Elimination System.

4.2 Assessment of Point Sources

Among the Rock Creek tributaries, only Piney Branch receives discharges from CSOs. There are four CSO outfalls on Piney Branch, and the remaining Rock Creek CSO outfalls are along the main banks of the Creek. A map of the CSO outfalls in the District is in Appendix B.

5.0 Technical Approach

5.1 Seasonal Variations and Critical Conditions

Because of the episodic nature of rainfall and storm water runoff, developing a daily load is not an effective means of determining the assimilative capacity of the receiving waters. Rather, looking at total loads over a range of conditions is a more relevant way to determine the maximum allowable loads. A statistical analysis of rainfall records over a period of fifty years was conducted and a dry year, a wet year, and an average rainfall year, were identified based on total annual rainfall and other factors such as average intensity and number of events per year (DCWASA, 2002a). The consecutive years of 1988, 1989, and 1990, represent a relatively dry year, a wet year, and an average precipitation year, respectively. These three years were considered the period of record for determining compliance with the water quality standards for the TMDL analysis. Determination of compliance with the water quality standards was based on the frequency of violations as calculated by the simulation model for these three years.

5.2 Rock Creek Small Tributaries Models

Rock Creek small tributaries were evaluated using a simple mass balance model that predicts daily water column concentrations of constituents of concern in the tributaries (ICPRB, 2003). The model, called the DC Small Tributaries TMDL Model and developed by the Interstate Commission for the Potomac River (ICPRB), treats each tributary as a “bathtub” which, on each day of the simulation period, receives a volume of water representing storm water runoff and a volume of water representing base flow from groundwater infiltration, and completely mixes. A brief overview of the model is in Appendix C.

The tributary model includes sub-models, one of which is for organic pollutants and one for inorganic pollutants (metals). These two sub-models predict daily water column concentrations of each pollutant in each of the tributaries under current conditions and allow evaluating load reduction scenarios by simple percent reductions of base and storm loads.

The constituents of the organic chemicals sub-model include the pesticides, chlordane, dieldrin, heptachlor epoxide, and dichloro-diphenyl-trichloroethane (DDT), none of which are currently in use. The organic chemicals sub-model also includes polycyclic aromatic hydrocarbons (PAHs), a class of chemicals present in coal, motor oils, gasoline, and their combustion products, and polychlorinated biphenyls (PCBs), the chemical constituents of a type of heavy oil that was formerly used in transformers, capacitors, heat exchangers, fluorescent light bulbs, and other products.

The constituents of the inorganic chemicals sub-model are arsenic, which has been used in pesticides, herbicides and wood preservatives; lead, which has been used as an additive in paints and gasoline; and also the metals, zinc and copper.

The sub-models used for different Rock Creek tributaries are listed in the following table.

Table 5-1: Rock Creek Tributary Models

Tributary	**Included in Organic Chemicals Model**	**Included in Inorganic Chemicals Model**
Broad Branch	√	
Dumbarton Oaks	√	
Fenwick Branch	√	
Klingle Valley Creek	√	
Luzon Branch	√	
Melvin Hazen Valley Branch	√	
Normanstone Creek	√	
Pinehurst Branch	√	
Portal Branch	√	
Piney Branch	√	√
Soapstone Creek	√	

The model was simulated using precipitation records for the three-year period of 1988 to 1990. The tributary model, in addition to predicting daily water column concentrations of modeled constituents, also compares these concentrations to the WQS in Section 2.3 in order to predict how many days WQS are violated during the three-year simulation period. Using the WQS guideline, four-day averages of predicted concentrations are used to compare with Class C CCC standards, and 30-day averages of predicted concentration are used to compare with Class D standards.

5.3 Scenario and Model Runs

A number of scenarios were run at different combinations of loading levels for the point and nonpoint sources. The loads simulated in the model include separate storm (SS) sewer load and CSO load. Among the Rock Creek tributaries, only Piney Branch receives CSO loads from the District's combined sewer system.

Degree of contribution to the existing pollution level has been considered in the allocation of load reductions for different scenarios. For the watersheds shared by both the District and Maryland, the load allocation was taken in proportion to the drainage areas situated within the jurisdiction. This is done assuming the land use and other factors affecting pollutant loads to be similar in both cases.

To determine allocated loads, several scenarios were run for each constituent before attaining an optimum balance that would eliminate any violations of the most stringent criteria within a constituent.

The selected scenarios for each part of the model resulted in the following load reduction levels for the District's storm water runoffs to meet the desired standards. Load reduction for CSOs in Piney Branch is described in a following section.

Table 5.2 Rock Creek Tributary Storm Water Reductions for Inorganics (Total Metals)

Tributary	Arsenic	Copper	Lead	Zinc
Piney Branch	65	65	75	0

Table 5.3 Rock Creek Tributary Storm Water Reductions for Organics

Tributary	**Chlordane**	**DDD**	**DDE**	**DDT**	**Dieldrin**
Broad Branch	85%	90%	92%	97%	80%
Dumbarton Oaks	85%	90%	92%	97%	80%
Fenwick Branch	85%	90%	92%	97%	80%
Klingle Valley	85%	90%	92%	97%	80%
Luzon Branch	85%	90%	92%	97%	80%
Melvin Hazen	85%	90%	92%	97%	80%
Normanstone Creek	85%	90%	92%	97%	80%
Pinehurst Branch	85%	90%	92%	97%	80%
Piney Branch	80%	90%	92%	97%	80%
Portal Branch	85%	90%	92%	97%	80%
Soapstone Creek	85%	90%	92%	97%	80%

Tributary	**Heptachlor Epoxide**	**PAH1**	**PAH2**	**PAH3**	**TPCB**
Broad Branch	90%	0%	98%	98%	Note 1
Dumbarton Oaks	90%	0%	98%	98%	Note 1
Fenwick Branch	90%	0%	98%	98%	Note 1
Klingle Valley	90%	0%	98%	98%	Note 1
Luzon Branch	90%	0%	98%	98%	Note 1
Melvin Hazen	90%	0%	98%	98%	Note 1
Normanstone Creek	90%	0%	98%	98%	Note 1
Pinehurst Branch	90%	0%	98%	98%	Note 1
Piney Branch	85%	0%	98%	96%	Note 1
Portal Branch	90%	0%	98%	98%	Note 1
Soapstone Creek	90%	0%	98%	98%	Note 1

Note 1: PCB contamination in the Rock Creek watershed is due to atmospheric deposition, historic spills, land applications (e.g., dust suppression), and sediment contamination. Atmospheric deposition is expected to decrease over time since the production and use of PCBs was banned in the 1970s. The releases from unidentified land sources are accounted for in the model by the CSO and storm water loads. For allocating PCB loads among sources, existing loads and watershed atmospheric deposition loads of PCBs were calculated. Existing loads were calculated using the DC small tributaries model. Available atmospheric deposition loads for the tributaries were based on average annual atmospheric deposition flux provided by Chesapeake Bay Program data (Chesapeake Bay Program, 1999). The atmospheric load represents much of the source of the CSO and storm water loads to the tributaries. Total PCB loads for sources other than atmospheric loads (i.e., land-based) were determined by subtracting atmospheric loads from existing loads in the watershed (see Appendix D for detailed calculations). For all the tributaries, except Piney Branch, 99.9 percent reductions of the existing loads were required to meet water quality standards. Piney Branch load reduction is described in a following section.

6.0 Total Maximum Daily Load (TMDL) Allocations and Margins of Safety

The following sections present existing loads and allocable TMDL loads for the Rock Creek tributaries. All loads are represented as an annual average loads based on three years (1988, 1989, 1990) of hydrologic conditions in the areas.

An explicit margin of safety equal to one percent of the TMDL load has been considered for the allocation for all the constituents, except for PCBs. For PCBs, load reduction is 99.9 percent for all the tributaries except Piney Branch. In Piney Branch, there is implicit margin safety with respect to CSOs, it is the recognized “first flush” effect. Although the model assumes a constant average concentration all the time, in reality capturing over 90 percent of the volume will capture initial highly concentrated flows, leaving flows that are less concentrated and diluted. Moreover, with regards to PAHs, the most stringent criterion of the 3 PAH groups were selected for the TMDL analysis.

6.1 Broad Branch Loads and TMDL

For the District of Columbia storm water runoff sources, the following table shows the existing loads and allowable TMDLs for Broad Branch organics that met the applicable WQS with a margin of safety of one percent. The total allowable loads for Broad Branch reflects the reductions needed in order to meet the following WQS: Class D criteria for Chlordane at 0.00059 ug/L; Class D criteria for DDD, DDE and DDT at 0.00059, respectively; Class D criteria for Dieldrin at 0.00014 ug/L; Class D criteria for Heptachlor Epoxide at 0.00011 ug/L; Class C-CCC for PAH 1 at 50 ug/L; and Class D for PAH2 and PAH2 at 0.031 ug/L, respectively. The allocable loads also meet Class C four-day average criteria for the constituents.

The following reductions were required to meet these WQS: Chlordane at 85%; DDD at 90%; DDE at 92%; DDT at 97%; Dieldrin at 80%; Heptachlor Epoxide at 90%; PAH 1 at 0%; PAH 2 at 98%; and PAH 3 at 98%. The PCB issues are discussed in section 5.3. Consequently, the allocations shown below reflect the atmospheric loads and resulting allocations at this time. The loads presented as “SS” includes loads from both separate storm water systems and direct runoffs.

Broad Branch Loads and TMDL – pounds/average year

Constituent	Broad Branch Existing Load			TMDL	1% MOS	Storm Water	Direct Runoff
	SS Load	CSO Load	Total Load				
Chlordane	2.451E-02	0.000E+00	2.451E-02	3.677E-03	3.677E-05	2.815E-03	8.254E-04
DDD	1.802E-02	0.000E+00	1.802E-02	1.802E-03	1.802E-05	1.379E-03	4.044E-04
DDE	3.956E-02	0.000E+00	3.956E-02	3.165E-03	3.165E-05	2.423E-03	7.105E-04
DDT	1.070E-01	0.000E+00	1.070E-01	3.209E-03	3.209E-05	2.457E-03	7.204E-04
Dieldrin	2.215E-03	0.000E+00	2.215E-03	4.430E-04	4.430E-06	3.391E-04	9.944E-05
Heptachlor Epoxide	3.719E-03	0.000E+00	3.719E-03	3.719E-04	3.719E-06	2.847E-04	8.348E-05
PAH1	1.686E+00	0.000E+00	1.686E+00	1.686E+00	1.686E-02	1.290E+00	3.784E-01
PAH2	9.913E+00	0.000E+00	9.913E+00	1.983E-01	1.983E-03	1.518E-01	4.451E-02
PAH3	6.307E+00	0.000E+00	6.307E+00	1.261E-01	1.261E-03	9.656E-02	2.832E-02

	SS Load	CSO Load	Total Load	Atmospheric Load	TMDL (Land-Based Source)	Storm Water (Land-Based Source)	Direct Runoff (Land-Based Source)
TPCB	2.098E-01	0.000E+00	2.098E-01	4.489E-02	1.649E-04	1.275E-04	3.738E-05

6.2 Dumbarton Oaks Loads and TMDL

For the District of Columbia storm water runoff sources, the following table shows the existing loads and allowable TMDLs for Dumberton Oaks organics that met the applicable WQS with a margin of safety of one percent. The total allowable loads for Dumberton Oaks reflects the reductions needed in order to meet the following WQS: Class D criteria for Chlordane at 0.00059 ug/L; Class D criteria for DDD, DDE and DDT at 0.00059, respectively; Class D criteria for Dieldrin at 0.00014 ug/L; Class D criteria for Heptachlor Epoxide at 0.00011 ug/L; Class C-CCC for PAH 1 at 50 ug/L; and Class D for PAH2 and PAH2 at 0.031 ug/L, respectively. The allocable loads also meet Class C four-day average criteria for the constituents.

The following reductions were required to meet these WQS: Chlordane at 85%; DDD at 90%; DDE at 92%; DDT at 97%; Dieldrin at 80%; Heptachlor Epoxide at 90%; PAH 1 at 0%; PAH 2 at 98%; and PAH 3 at 98%. The PCB issues are discussed in section 5.3. Consequently, the allocations shown below reflect the atmospheric loads and resulting allocations at this time.

Dumbarton Oaks Loads and TMDL – pounds/average year

Constituent	Dumberton Oaks Existing Load			TMDL	1% MOS	Storm Water	Direct Runoff
	SS Load	CSO Load	Total Load				
Chlordane	4.836E-03	0.000E+00	4.836E-03	7.254E-04	7.254E-06	6.225E-05	6.559E-04
DDD	2.798E-03	0.000E+00	2.798E-03	2.798E-04	2.798E-06	2.401E-05	2.530E-04
DDE	7.346E-03	0.000E+00	7.346E-03	5.877E-04	5.877E-06	5.043E-05	5.313E-04
DDT	1.955E-02	0.000E+00	1.955E-02	5.864E-04	5.864E-06	5.032E-05	5.302E-04
Dieldrin	3.299E-04	0.000E+00	3.299E-04	6.597E-05	6.597E-07	5.661E-06	5.965E-05
Heptachlor Epoxide	6.380E-04	0.000E+00	6.380E-04	6.380E-05	6.380E-07	5.475E-06	5.769E-05
PAH1	3.294E-01	0.000E+00	3.294E-01	3.294E-01	3.294E-03	2.827E-02	2.979E-01
PAH2	1.989E+00	0.000E+00	1.989E+00	3.977E-02	3.977E-04	3.413E-03	3.596E-02
PAH3	1.272E+00	0.000E+00	1.272E+00	2.543E-02	2.543E-04	2.183E-03	2.300E-02

	SS Load	CSO Load	Total Load	Atmospheric Load	TMDL (Land Based Source)	Storm Water (Land-Based Source)	Direct Runoff (Land-Based Source)
TPCB	4.075E-02	0.000E+00	4.075E-02	9.186E-03	3.157E-05	2.736E-06	2.883E-05

6.3 Fenwick Branch Loads and TMDL

For the District of Columbia storm water runoff sources, the following table shows the existing loads and allowable TMDLs for Fenwick Branch Organics that met the applicable WQS with a margin of safety of one percent. The total allowable loads for Fenwick Branch reflects the reductions needed in order to meet the following WQS: Class D criteria for Chlordane at 0.00059 ug/L; Class D criteria for DDD, DDE and DDT at 0.00059, respectively; Class D criteria for Dieldrin at 0.00014 ug/L; Class D criteria for Heptachlor Epoxide at 0.00011 ug/L; Class C-CCC for PAH 1 at 50 ug/L; and Class D for PAH2 and PAH2 at 0.031 ug/L, respectively. The allocable loads also meet Class C four-day average criteria for the constituents.

The following reductions were required to meet these WQS: Chlordane at 85%; DDD at 90%; DDE at 92%; DDT at 97%; Dieldrin at 80%; Heptachlor Epoxide at 90%; PAH 1 at 0%; PAH 2 at 98%; and PAH 3 at 98%. The PCB issues are discussed in section 5.3. Consequently, the allocations shown below reflect the atmospheric loads and resulting allocations at this time.

Approximately 66.5 percent of Fenwick Branch drainage area is in Maryland. Accordingly 66.5% of the Total Loads and Allocations are directed to Maryland.

Maryland Fenwick Branch Loads and TMDL – pounds/average year

Constituent	Maryland Fenwick Branch Existing Load	TMDL	1% MOS	Maryland Total Allocable
Chlordane	7.706E-03	1.156E-03	1.156E-05	1.144E-03
DDD	6.381E-03	6.381E-04	6.381E-06	6.317E-04
DDE	1.287E-02	1.030E-03	1.030E-05	1.020E-03
DDT	3.511E-02	1.053E-03	1.053E-05	1.043E-03
Dieldrin	7.979E-04	1.596E-04	1.596E-06	1.580E-04
Heptachlor Epoxide	1.260E-03	1.260E-04	1.260E-06	1.247E-04
PAH1	5.330E-01	5.330E-01	5.330E-03	5.276E-01
PAH2	3.085E+00	6.170E-02	6.170E-04	6.109E-02
PAH3	1.957E+00	3.914E-02	3.914E-04	3.875E-02

	Maryland Load	Atmospheric Load	TMDL (Land-Based)
TPCB	6.654E-02	1.369E-02	5.285E-05

Approximately 33.5 percent of Fenwick Branch drainage area is in the District of Columbia. Accordingly 33.5% of the Total Loads and Allocations are directed to the District of Columbia.

District of Columbia Fenwick Branch Loads and TMDL – pounds/average year

Constituent	Fenwick Branch Existing Load			TMDL	1% MOS	Storm Water	Direct Runoff
	SS Load	CSO Load	Total Load				
Chlordane	3.881E-03	0.000E+00	3.881E-03	5.822E-04	5.822E-06	4.926E-04	8.376E-05
DDD	3.214E-03	0.000E+00	3.214E-03	3.214E-04	3.214E-06	2.719E-04	4.624E-05
DDE	6.484E-03	0.000E+00	6.484E-03	5.187E-04	5.187E-06	4.389E-04	7.462E-05
DDT	1.768E-02	0.000E+00	1.768E-02	5.305E-04	5.305E-06	4.489E-04	7.632E-05
Dieldrin	4.019E-04	0.000E+00	4.019E-04	8.038E-05	8.038E-07	6.801E-05	1.156E-05
Heptachlor Epoxide	6.346E-04	0.000E+00	6.346E-04	6.346E-05	6.346E-07	5.369E-05	9.130E-06
PAH1	2.684E-01	0.000E+00	2.684E-01	2.684E-01	2.684E-03	2.271E-01	3.862E-02
PAH2	1.554E+00	0.000E+00	1.554E+00	3.108E-02	3.108E-04	2.630E-02	4.471E-03
PAH3	9.857E-01	0.000E+00	9.857E-01	1.971E-02	1.971E-04	1.668E-02	2.836E-03

	SS Load	CSO Load	Total Load	Atmospheric Load	TMDL (Land-Based Source)	Storm Water (Land-Based Source)	Direct Runoff (Land-Based Source)
TPCB	3.352E-02	0.000E+00	3.352E-02	6.896E-03	2.662E-05	2.275E-05	3.868E-06

6.4 Klingle Valley Creek Loads and TMDL

For the District of Columbia storm water runoff sources, the following table shows the existing loads and allowable TMDLs for Klingle Valley Creek organics that met the applicable WQS with a margin of safety of one percent. The total allowable loads for Klingle Valley Creek reflects the reductions needed in order to meet the following WQS: Class D criteria for Chlordane at 0.00059 ug/L; Class D criteria for DDD, DDE and DDT at 0.00059, respectively; Class D criteria for Dieldrin at 0.00014 ug/L; Class D criteria for Heptachlor Epoxide at 0.00011 ug/L; Class C-CCC for PAH 1 at 50 ug/L; and Class D for PAH2 and PAH2 at 0.031 ug/L, respectively. The allocable loads also meet Class C four-day average criteria for the constituents.

The following reductions were required to meet these WQS: Chlordane at 85%; DDD at 90%; DDE at 92%; DDT at 97%; Dieldrin at 80%; Heptachlor Epoxide at 90%; PAH 1 at 0%; PAH 2 at 98%; and PAH 3 at 98%. The PCB issues are discussed in section 5.3. Consequently, the allocations shown below reflect the atmospheric loads and resulting allocations at this time.

Klingle Valley Creek Loads and TMDL – pounds/average year

Constituent	Klingle Valley Existing Load			TMDL	1% MOS	Storm Water	Direct Runoff
	SS Load	CSO Load	Total Load				
Chlordane	9.790E-03	0.000E+00	9.790E-03	1.469E-03	1.469E-05	1.373E-03	8.112E-05
DDD	5.855E-03	0.000E+00	5.855E-03	5.855E-04	5.855E-06	5.473E-04	3.234E-05
DDE	1.499E-02	0.000E+00	1.499E-02	1.199E-03	1.199E-05	1.121E-03	6.623E-05
DDT	3.997E-02	0.000E+00	3.997E-02	1.199E-03	1.199E-05	1.121E-03	6.623E-05
Dieldrin	6.949E-04	0.000E+00	6.949E-04	1.390E-04	1.390E-06	1.299E-04	7.677E-06
Heptachlor Epoxide	1.316E-03	0.000E+00	1.316E-03	1.316E-04	1.316E-06	1.230E-04	7.269E-06
PAH1	6.678E-01	0.000E+00	6.678E-01	6.678E-01	6.678E-03	6.242E-01	3.689E-02
PAH2	4.018E+00	0.000E+00	4.018E+00	8.036E-02	8.036E-04	7.511E-02	4.439E-03
PAH3	2.568E+00	0.000E+00	2.568E+00	5.135E-02	5.135E-04	4.800E-02	2.837E-03

	SS Load	CSO Load	Total Load	Atmospheric Load	TMDL (Land-Based Source)	Storm Water (Land-Based Source)	Direct Runoff (Land-Based Source)
TPCB	8.266E-02	0.000E+00	8.266E-02	1.863E-02	6.403E-05	6.046E-05	3.573E-06

6.5 Luzon Branch Loads and TMDL

For the District of Columbia storm water runoff sources, the following table shows the existing loads and allowable TMDLs for Luzon Branch organics that met the applicable WQS with a margin of safety of one percent. The total allowable loads for Luzon Branch reflects the reductions needed in order to meet the following WQS: Class D criteria for Chlordane at 0.00059 ug/L; Class D criteria for DDD, DDE and DDT at 0.00059, respectively; Class D criteria for Dieldrin at 0.00014 ug/L; Class D criteria for Heptachlor Epoxide at 0.00011 ug/L; Class C-CCC for PAH 1 at 50 ug/L; and Class D for PAH2 and PAH2 at 0.031 ug/L, respectively. The allocable loads also meet Class C four-day average criteria for the constituents.

The following reductions were required to meet these WQS: Chlordane at 85%; DDD at 90%; DDE at 92%; DDT at 97%; Dieldrin at 80%; Heptachlor Epoxide at 90%; PAH 1 at 0%; PAH 2 at 98%; and PAH 3 at 98%. The PCB issues are discussed in section 5.3. Consequently, the allocations shown below reflect the atmospheric loads and resulting allocations at this time.

Luzon Branch Loads and TMDL – pounds/average year

Constituent	Luzon Branch Existing Load			TMDL	1% MOS	Storm Water	Direct Runoff
	SS Load	CSO Load	Total Load				
Chlordane	1.746E-02	0.000E+00	1.746E-02	2.618E-03	2.618E-05	4.790E-04	2.113E-03
DDD	1.068E-02	0.000E+00	1.068E-02	1.068E-03	1.068E-05	1.954E-04	8.620E-04
DDE	2.687E-02	0.000E+00	2.687E-02	2.149E-03	2.149E-05	3.932E-04	1.735E-03
DDT	7.175E-02	0.000E+00	7.175E-02	2.153E-03	2.153E-05	3.938E-04	1.737E-03
Dieldrin	1.273E-03	0.000E+00	1.273E-03	2.546E-04	2.546E-06	4.658E-05	2.055E-04
Heptachlor Epoxide	2.377E-03	0.000E+00	2.377E-03	2.377E-04	2.377E-06	4.348E-05	1.918E-04
PAH1	1.192E+00	0.000E+00	1.192E+00	1.192E+00	1.192E-02	2.180E-01	9.617E-01
PAH2	7.153E+00	0.000E+00	7.153E+00	1.431E-01	1.431E-03	2.617E-02	1.155E-01
PAH3	4.569E+00	0.000E+00	4.569E+00	9.138E-02	9.138E-04	1.672E-02	7.375E-02

	SS Load	CSO Load	Total Load	Atmospheric Load	TMDL (Land-Based Source)	Storm Water (Land-Based Source)	Direct Runoff (Land-Based Source)
TPCB	1.476E-01	0.000E+00	1.476E-01	3.304E-02	1.145E-04	2.117E-05	9.337E-05

6.6 Melvin Hazen Valley Branch Loads and TMDL

For the District of Columbia storm water runoff sources, the following table shows the existing loads and allowable TMDLs for Melvin Hazen Valley Branch organics that met the applicable WQS with a margin of safety of one percent. The total allowable loads for Melvin Hazen Valley Branch reflects the reductions needed in order to meet the following WQS: Class D criteria for Chlordane at 0.00059 ug/L; Class D criteria for DDD, DDE and DDT at 0.00059, respectively; Class D criteria for Dieldrin at 0.00014 ug/L; Class D criteria for Heptachlor Epoxide at 0.00011 ug/L; Class C-CCC for PAH 1 at 50 ug/L; and Class D for PAH2 and PAH2 at 0.031 ug/L, respectively. The allocable loads also meet Class C four-day average criteria for the constituents.

The following reductions were required to meet these WQS: Chlordane at 85%; DDD at 90%; DDE at 92%; DDT at 97%; Dieldrin at 80%; Heptachlor Epoxide at 90%; PAH 1 at 0%; PAH 2 at 98%; and PAH 3 at 98%. The PCB issues are discussed in section 5.3. Consequently, the allocations shown below reflect the atmospheric loads and resulting allocations at this time.

Melvin Hazen Valley Branch Loads and TMDL – pounds/average year

Constituent	Melvin Hazen Existing Load			TMDL	1% MOS	Storm Water	Direct Runoff
	SS Load	CSO Load	Total Load				
Chlordane	4.939E-03	0.000E+00	4.939E-03	7.409E-04	7.409E-06	5.321E-04	2.013E-04
DDD	3.032E-03	0.000E+00	3.032E-03	3.032E-04	3.032E-06	2.178E-04	8.238E-05
DDE	7.608E-03	0.000E+00	7.608E-03	6.087E-04	6.087E-06	4.372E-04	1.654E-04
DDT	2.032E-02	0.000E+00	2.032E-02	6.097E-04	6.097E-06	4.379E-04	1.657E-04
Dieldrin	3.616E-04	0.000E+00	3.616E-04	7.231E-05	7.231E-07	5.194E-05	1.965E-05
Heptachlor Epoxide	6.737E-04	0.000E+00	6.737E-04	6.737E-05	6.737E-07	4.839E-05	1.831E-05
PAH1	3.372E-01	0.000E+00	3.372E-01	3.372E-01	3.372E-03	2.422E-01	9.163E-02
PAH2	2.024E+00	0.000E+00	2.024E+00	4.047E-02	4.047E-04	2.907E-02	1.100E-02
PAH3	1.293E+00	0.000E+00	1.293E+00	2.585E-02	2.585E-04	1.857E-02	7.024E-03

	SS Load	CSO Load	Total Load	Atmospheric Load	TMDL (Land-Based Source)	Storm Water (Land-Based Source)	Direct Runoff (Land-Based Source)
TPCB	4.177E-02	0.000E+00	4.177E-02	9.302E-03	3.247E-05	2.355E-05	8.911E-06

6.7 Normanstone Creek Loads and TMDL

For the District of Columbia storm water runoff sources, the following table shows the existing loads and allowable TMDLs for Normanstone Creek organics that met the applicable WQS with a margin of safety of one percent. The total allowable loads for Normanstone Creek reflects the reductions needed in order to meet the following WQS: Class D criteria for Chlordane at 0.00059 ug/L; Class D criteria for DDD, DDE and DDT at 0.00059, respectively; Class D criteria for Dieldrin at 0.00014 ug/L; Class D criteria for Heptachlor Epoxide at 0.00011 ug/L; Class C-CCC for PAH 1 at 50 ug/L; and Class D for PAH2 and PAH2 at 0.031 ug/L, respectively. The allocable loads also meet Class C four-day average criteria for the constituents.

The following reductions were required to meet these WQS: Chlordane at 85%; DDD at 90%; DDE at 92%; DDT at 97%; Dieldrin at 80%; Heptachlor Epoxide at 90%; PAH 1 at 0%; PAH 2 at 98%; and PAH 3 at 98%. The PCB issues are discussed in section 5.3. Consequently, the allocations shown below reflect the atmospheric loads and resulting allocations at this time.

Normanstone Creek Loads and TMDL – pounds/average year

Constituent	Normanstone Creek Existing Load			TMDL	1% MOS	Storm Water	Direct Runoff
	SS Load	CSO Load	Total Load				
Chlordane	6.331E-03	0.000E+00	6.331E-03	9.497E-04	9.497E-06	7.771E-04	1.631E-04
DDD	4.069E-03	0.000E+00	4.069E-03	4.069E-04	4.069E-06	3.329E-04	6.988E-05
DDE	9.864E-03	0.000E+00	9.864E-03	7.891E-04	7.891E-06	6.457E-04	1.355E-04
DDT	2.643E-02	0.000E+00	2.643E-02	7.928E-04	7.928E-06	6.487E-04	1.362E-04
Dieldrin	4.893E-04	0.000E+00	4.893E-04	9.786E-05	9.786E-07	8.008E-05	1.681E-05
Heptachlor Epoxide	8.867E-04	0.000E+00	8.867E-04	8.867E-05	8.867E-07	7.255E-05	1.523E-05
PAH1	4.330E-01	0.000E+00	4.330E-01	4.330E-01	4.330E-03	3.543E-01	7.437E-02
PAH2	2.586E+00	0.000E+00	2.586E+00	5.172E-02	5.172E-04	4.232E-02	8.883E-03
PAH3	1.650E+00	0.000E+00	1.650E+00	3.301E-02	3.301E-04	2.701E-02	5.669E-03

	SS Load	CSO Load	Total Load	Atmospheric Load	TMDL (Land-Based Source)	Storm Water (Land-Based Source)	Direct Runoff (Land-Based Source)
TPCB	5.369E-02	0.000E+00	5.369E-02	1.186E-02	4.183E-05	3.457E-05	7.257E-06

6.8 Pinehurst Branch Loads and TMDL

For the District of Columbia storm water runoff sources, the following table shows the existing loads and allowable TMDLs for Pinehurst Branch organics that met the applicable WQS with a margin of safety of one percent. The total allowable loads for Pinehurst Branch reflects the reductions needed in order to meet the following WQS: Class D criteria for Chlordane at 0.00059 ug/L; Class D criteria for DDD, DDE and DDT at 0.00059, respectively; Class D criteria for Dieldrin at 0.00014 ug/L; Class D criteria for Heptachlor Epoxide at 0.00011 ug/L; Class C-CCC for PAH 1 at 50 ug/L; and Class D for PAH2 and PAH2 at 0.031 ug/L, respectively. The allocable loads also meet Class C four-day average criteria for the constituents.

The following reductions were required to meet these WQS: Chlordane at 85%; DDD at 90%; DDE at 92%; DDT at 97%; Dieldrin at 80%; Heptachlor Epoxide at 90%; PAH 1 at 0%; PAH 2 at 98%; and PAH 3 at 98%. The PCB issues are discussed in section 5.3. Consequently, the allocations shown below reflect the atmospheric loads and resulting allocations at this time.

Approximately 30 percent of Pinehurst Branch drainage area is in Maryland. Accordingly 30% the Total Loads and Allocations are directed to Maryland.

Maryland Pinehurst Branch Loads and TMDL – pounds/average year

Constituent	Maryland Pinehurst Branch Load	TMDL	1% MOS	Maryland Total Allocable
Chlordane	3.199E-03	4.799E-04	4.799E-06	4.751E-04
DDD	2.870E-03	2.870E-04	2.870E-06	2.841E-04
DDE	5.479E-03	4.383E-04	4.383E-06	4.339E-04
DDT	1.503E-02	4.509E-04	4.509E-06	4.464E-04
Dieldrin	3.625E-04	7.251E-05	7.251E-07	7.178E-05
Heptachlor Epoxide	5.510E-04	5.510E-05	5.510E-07	5.455E-05
PAH1	2.222E-01	2.222E-01	2.222E-03	2.200E-01
PAH2	1.271E+00	2.543E-02	2.543E-04	2.517E-02
PAH3	8.045E-01	1.609E-02	1.609E-04	1.593E-02

	Maryland Load	Atmospheric Load	TMDL (Land-Based)
TPCB	2.781E-02	5.618E-03	2.219E-05

Approximately 70 percent of Pinehurst Branch drainage area is in the District of Columbia. Accordingly 70% of the Total Loads and Allocations are directed to the District of Columbia.

District of Columbia Pinehurst Branch Loads and TMDL – pounds/average year

Constituent	Normanstone Creek Existing Load			TMDL	1% MOS	Storm Water	Direct Runoff
	SS Load	CSO Load	Total Load				
Chlordane	7.506E-03	0.000E+00	7.506E-03	1.126E-03	1.126E-05	6.595E-04	4.551E-04
DDD	6.733E-03	0.000E+00	6.733E-03	6.733E-04	6.733E-06	3.944E-04	2.722E-04
DDE	1.285E-02	0.000E+00	1.285E-02	1.028E-03	1.028E-05	6.023E-04	4.157E-04
DDT	3.526E-02	0.000E+00	3.526E-02	1.058E-03	1.058E-05	6.196E-04	4.277E-04
Dieldrin	8.505E-04	0.000E+00	8.505E-04	1.701E-04	1.701E-06	9.963E-05	6.876E-05
Heptachlor Epoxide	1.293E-03	0.000E+00	1.293E-03	1.293E-04	1.293E-06	7.572E-05	5.226E-05
PAH1	5.213E-01	0.000E+00	5.213E-01	5.213E-01	5.213E-03	3.053E-01	2.107E-01
PAH2	2.982E+00	0.000E+00	2.982E+00	5.965E-02	5.965E-04	3.494E-02	2.411E-02
PAH3	1.887E+00	0.000E+00	1.887E+00	3.775E-02	3.775E-04	2.211E-02	1.526E-02

	SS Load	CSO Load	Total Load	Atmospheric Load	TMDL (Land-Based Source)	Storm Water (Land-Based Source)	Direct Runoff (Land-Based Source)
TPCB	6.524E-02	0.000E+00	6.524E-02	1.311E-02	5.213E-05	3.085E-05	2.129E-05

6.9 Piney Branch Loads and TMDL

Piney Branch loads are established for both inorganics and organics. For the District of Columbia storm water runoff sources, the following table shows the existing loads and allowable TMDLs for Piney Branch metals and organics that met the applicable WQS with a margin of safety of one percent. The total allowable loads for Piney Branch reflects the reductions needed in order to meet the following WQS: Class D criteria for Arsenic at 0.14 ug/L; Class C, CCC criteria for Copper at 12.31, Lead at 2.79, and Zinc at 113.29 ug/L; Class D criteria for Chlordane at 0.00059 ug/L; Class D criteria for DDD, DDE and DDT at 0.00059, respectively; Class D criteria for Dieldrin at 0.00014 ug/L; Class D criteria for Heptachlor Epoxide at 0.00011 ug/L; Class C-CCC for PAH 1 at 50 ug/L; and Class D for PAH2 and PAH2 at 0.031 ug/L, respectively. The allocable loads also meet Class C four-day average criteria for the constituents.

The following reductions were required for the District's storm water runoffs to meet these WQS: Total Arsenic at 65%; Total Copper at 65%; Total Lead at 75%; Total Zinc at 0%; Chlordane at 80%; DDD at 90%; DDE at 92%; DDT at 97%; Dieldrin at 80%; Heptachlor Epoxide at 85%; PAH 1 at 0%; PAH 2 at 98%; and PAH 3 at 96%. The reduction for CSOs is 96.5% for all constituents as the allocation scenario was run with the recommended plan for CSOs in the DCWASA LTCP (DCWASA, 2002). No margin of safety applied for the CSO loads, as there is implicit safety included in the analysis with first flush effects. The PCB issues are discussed in section 5.3. Although no loads are allocated for land-based sources, the reductions needed to meet water quality standards are 96.5 percent for CSOs and 99.9 percent for storm water loads, with sources of loads for both CSOs and storm water could be atmospheric and/or land-based. As shown below, the atmospheric loading contribution calculated is greater than the existing load; hence, no land-based allocation was made at this time. Therefore, the allocations shown below reflect the atmospheric loads and resulting allocations at this time.

Piney Branch Loads and TMDL – pounds/average year

Constituent	Piney Branch Existing Load			TMDL	1% MOS	Storm Water and CSO	Direct Runoff
	SS Load	CSO Load	Total Load				
Arsenic (total)	1.236E-01	4.632E-01	5.868E-01	5.966E-02	4.324E-04	3.107E-02	2.816E-02
Copper (total)	4.297E+00	2.515E+01	2.944E+01	2.395E+00	1.504E-02	1.401E+00	9.793E-01
Lead (total)	2.000E+00	2.647E+01	2.847E+01	1.438E+00	4.999E-03	1.108E+00	3.255E-01
Zinc (total)	1.255E+01	7.047E+01	8.302E+01	1.505E+01	1.255E-01	6.750E+00	8.171E+00
Chlordane	7.978E-04	3.252E-03	4.050E-03	2.749E-04	1.596E-06	1.694E-04	1.039E-04
DDD	9.269E-04	9.926E-04	1.920E-03	1.279E-04	9.269E-07	6.659E-05	6.036E-05
DDE	1.495E-03	4.401E-03	5.895E-03	2.755E-04	1.196E-06	1.965E-04	7.785E-05
DDT	4.183E-03	1.132E-02	1.550E-02	5.266E-04	1.255E-06	4.436E-04	8.172E-05
Dieldrin	1.203E-04	9.595E-05	2.163E-04	2.746E-05	2.406E-07	1.156E-05	1.567E-05
Heptachlor Epoxide	1.641E-04	3.166E-04	4.808E-04	3.584E-05	2.462E-07	1.957E-05	1.603E-05
PAH1	5.629E-02	2.179E-01	2.742E-01	6.401E-02	5.629E-04	2.680E-02	3.665E-02
PAH2	3.078E-01	1.376E+00	1.684E+00	5.494E-02	6.156E-05	5.087E-02	4.009E-03
PAH3	1.930E-01	8.874E-01	1.080E+00	3.917E-02	7.720E-05	3.407E-02	5.027E-03

	SS Load	CSO Load	Total Load	Atmospheric Load	Total Allocable Load (Land-Based)
TPCB	7.111E-03	2.667E-02	3.378E-02	1.275E-01	0

6.10 Portal Branch Loads and TMDL

For the District of Columbia storm water runoff sources, the following table shows the existing loads and allowable TMDLs for Portal Branch organics that met the applicable WQS with a margin of safety of one percent. The total allowable loads for Portal Branch reflects the reductions needed in order to meet the following WQS: Class D criteria for Chlordane at 0.00059 ug/L; Class D criteria for DDD, DDE and DDT at 0.00059, respectively; Class D criteria for Dieldrin at 0.00014 ug/L; Class D criteria for Heptachlor Epoxide at 0.00011 ug/L; Class C-CCC for PAH 1 at 50 ug/L; and Class D for PAH2 and PAH2 at 0.031 ug/L, respectively. The allocable loads also meet Class C four-day average criteria for the constituents.

The following reductions were required to meet these WQS: Chlordane at 85%; DDD at 90%; DDE at 92%; DDT at 97%; Dieldrin at 80%; Heptachlor Epoxide at 90%; PAH 1 at 0%; PAH 2 at 98%; and PAH 3 at 98%. The PCB issues are discussed in section 5.3. Consequently, the allocations shown below reflect the atmospheric loads and resulting allocations at this time.

Approximately 65 percent of Portal Branch drainage area is in Maryland. Accordingly 65% the Total Loads and Allocations are directed to Maryland.

Maryland Portal Branch Loads and TMDL – pounds/average year

Constituent	Maryland Portal Branch Load	TMDL	1% MOS	Maryland Total Allocable
Chlordane	2.592E-03	3.888E-04	3.888E-06	3.849E-04
DDD	2.161E-03	2.161E-04	2.161E-06	2.140E-04
DDE	4.339E-03	3.471E-04	3.471E-06	3.436E-04
DDT	1.184E-02	3.552E-04	3.552E-06	3.516E-04
Dieldrin	2.705E-04	5.410E-05	5.410E-07	5.356E-05
Heptachlor Epoxide	4.257E-04	4.257E-05	4.257E-07	4.214E-05
PAH1	1.793E-01	1.793E-01	1.793E-03	1.775E-01
PAH2	1.037E+00	2.074E-02	2.074E-04	2.053E-02
PAH3	6.576E-01	1.315E-02	1.315E-04	1.302E-02

	Maryland Load	Atmospheric Load	TMDL (Land-Based)
TPCB	2.239E-02	4.720E-03	1.767E-02

Approximately 35 percent of Portal Branch drainage area is in the District of Columbia. Accordingly 35% of the Total Loads and Allocations are directed to the District of Columbia.

District of Columbia Portal Branch Loads and TMDL – pounds/average year

Constituent	Portal Branch Existing Load			TMDL	1% MOS	Storm Water	Direct Runoff
	SS Load	CSO Load	Total Load				
Chlordane	1.409E-03	0.000E+00	1.409E-03	2.113E-04	2.113E-06	1.824E-04	2.682E-05
DDD	1.175E-03	0.000E+00	1.175E-03	1.175E-04	1.175E-06	1.014E-04	1.491E-05
DDE	2.358E-03	0.000E+00	2.358E-03	1.886E-04	1.886E-06	1.628E-04	2.395E-05
DDT	6.435E-03	0.000E+00	6.435E-03	1.930E-04	1.930E-06	1.666E-04	2.451E-05
Dieldrin	1.470E-04	0.000E+00	1.470E-04	2.940E-05	2.940E-07	2.538E-05	3.733E-06
Heptachlor Epoxide	2.314E-04	0.000E+00	2.314E-04	2.314E-05	2.314E-07	1.997E-05	2.937E-06
PAH1	9.746E-02	0.000E+00	9.746E-02	9.746E-02	9.746E-04	8.411E-02	1.237E-02
PAH2	5.636E-01	0.000E+00	5.636E-01	1.127E-02	1.127E-04	9.728E-03	1.431E-03
PAH3	3.574E-01	0.000E+00	3.574E-01	7.148E-03	7.148E-05	6.169E-03	9.074E-04

	SS Load	CSO Load	Total Load	Atmospheric Load	TMDL (Land-Based Source)	Storm Water (Land-Based Source)	Direct Runoff (Land-Based Source)
TPCB	1.217E-02	0.000E+00	1.217E-02	2.542E-03	9.628E-06	8.394E-06	1.235E-06

6.11 Soapstone Creek Loads and TMDL

For the District of Columbia storm water runoff sources, the following table shows the existing loads and allowable TMDLs for Soapstone Creek organics that met the applicable WQS with a margin of safety of one percent. The total allowable loads for Soapstone Creek reflects the reductions needed in order to meet the following WQS: Class D criteria for Chlordane at 0.00059 ug/L; Class D criteria for DDD, DDE and DDT at 0.00059, respectively; Class D criteria for Dieldrin at 0.00014 ug/L; Class D criteria for Heptachlor Epoxide at 0.00011 ug/L; Class C-CCC for PAH 1 at 50 ug/L; and Class D for PAH2 and PAH2 at 0.031 ug/L, respectively. The allocable loads also meet Class C four-day average criteria for the constituents.

The following reductions were required to meet these WQS: Chlordane at 85%; DDD at 90%; DDE at 92%; DDT at 97%; Dieldrin at 80%; Heptachlor Epoxide at 90%; PAH 1 at 0%; PAH 2 at 98%; and PAH 3 at 98%. The PCB issues are discussed in section 5.3. Consequently, the allocations shown below reflect the atmospheric loads and resulting allocations at this time.

Soapstone Creek Loads and TMDL – pounds/average year

Constituent	Portal Branch Existing Load			TMDL	1% MOS	Storm Water	Direct Runoff
	SS Load	CSO Load	Total Load				
Chlordane	1.573E-02	0.000E+00	1.573E-02	2.359E-03	2.359E-05	1.965E-03	3.701E-04
DDD	8.741E-03	0.000E+00	8.741E-03	8.741E-04	8.741E-06	7.282E-04	1.371E-04
DDE	2.367E-02	0.000E+00	2.367E-02	1.894E-03	1.894E-05	1.578E-03	2.971E-04
DDT	6.283E-02	0.000E+00	6.283E-02	1.885E-03	1.885E-05	1.570E-03	2.957E-04
Dieldrin	1.022E-03	0.000E+00	1.022E-03	2.044E-04	2.044E-06	1.703E-04	3.207E-05
Heptachlor Epoxide	2.030E-03	0.000E+00	2.030E-03	2.030E-04	2.030E-06	1.691E-04	3.184E-05
PAH1	1.070E+00	0.000E+00	1.070E+00	1.070E+00	1.070E-02	8.913E-01	1.679E-01
PAH2	6.483E+00	0.000E+00	6.483E+00	1.297E-01	1.297E-03	1.080E-01	2.034E-02
PAH3	4.148E+00	0.000E+00	4.148E+00	8.297E-02	8.297E-04	6.912E-02	1.302E-02

	SS Load	CSO Load	Total Load	Atmospheric Load	TMDL (Land-Based Source)	Storm Water (Land-Based Source)	Direct Runoff (Land-Based Source)
TPCB	1.322E-01	0.000E+00	1.322E-01	3.029E-02	1.019E-04	8.579E-05	1.616E-05

7.0 Reasonable Assurance

The District of Columbia has several programs in place to control the effects of storm water runoff and promote nonpoint source pollution prevention and control. The District is a signatory to the Chesapeake Bay Agreement, pledging to reduce nutrient loads to the Bay by 40 percent or more by the year 2010. In addition, other source control measures described in the following will help reduce toxics pollution of the District's waters.

7.1 Agreements

On June 28, 2000, Mayor Williams, Governor Glendening, U.S. EPA and others signed the new Chesapeake Bay Agreement. The goals of the agreement include:

> "Achieve and maintain the water quality necessary to support the aquatic living resources of the Bay and its tributaries and to protect human health"
>
> and
>
> "By 2010, correct the nutrient- and sediment-related problems in the Chesapeake Bay and its tidal tributaries sufficiently to remove the Bay and the tidal portions of its tributaries from the list of impaired waters under the Clean Water Act"

Thus, an agreement is in place that clearly demonstrates a commitment to the restoration of Rock Creek and tributaries by the year 2010. This establishes a completion date for implementation of those activities necessary to achieve the load reductions allocated in this TMDL.

7.2 Source Control Plan

7.2.1 Upstream Target Load Reductions for Maryland

Maryland has committed to a 40% nitrogen and phosphorus reduction in the Bay Agreement and has developed tributary strategies that will achieve that reduction. Both Prince Georges and Montgomery Counties have aggressive and effective storm water management programs. This will help reduce organic and inorganic pollutants.

7.2.2 CSO Load Reductions

The only tributary impacted by CSOs is Piney Branch. The DC WASA has proposed a storage system in Rock Creek and other parts of the combined sewer system in the Final CSO LTCP (DCWASA, 2002). The CSO LTCP has been approved by DCDOH. When implemented, the plan will significantly reduce CSOs to Piney Branch.

7.2.3 Storm Water Load Reductions

The District of Columbia Water Pollution Control Act (DC Law 5-188) authorizes the establishment of the District's Water Quality Standards (21 DCMR, Chapter 10) and the control of sources of pollution such as storm water management (21 DCMR, Chapter 5).

The DC Department of Health has an extensive storm water management, sediment, and erosion control program for construction activities. It also has a Nonpoint Source Management Plan to address the reduction of nonpoint source pollution (D.C. Department of Health, 2002).

A number of activities to reduce pollutant runoff are carried out as part of the Municipal Separate Storm Sewer Permit for the District of Columbia. The most pertinent of these are contained in the storm water management plan. The plan provides additional mechanisms for achieving the load reductions needed.

Major currently operating programs in DC that reduce loads are as follows:

1. Street sweeping programs by the Department of Public Works.
2. Requirements for storm water treatment on all new development and earth disturbing activities such as road construction.
3. Regulatory programs restricting illegal discharges to storm sewers and enforcing the erosion control laws.
4. Environmental education and citizen outreach programs to reduce pollution causing activities.

Federal lands encompass approximately 18 percent of the land inside DC, which contribute flow to storm water to Rock Creek. The federal facilities such as the National Park Service will need to develop storm water management plans to reduce their loads and implement those plans.

In terms of legacy compounds such as PCBs, many of these compounds are banned from widespread use and/or strictly regulated under the Toxics Substances Control Act (TSCA). As toxics and other pollutants are associated with particles and washes to streams during wet weather conditions, different storm water management initiatives, including BMPs that reduce suspended solids loads to the receiving water bodies will, in turn, reduce toxics pollution. In addition DCWASA has pretreatment programs to limit industrial discharge to the sanitary sewer systems.

7.2.4 NPDES Permits

Additional requirements, as necessary, will be added to all permits that are issued, reissued or modified by U.S. EPA and certified by DC DOH after the approval of this TMDL. Permits, as an EPA policy, are not reopened to incorporate TMDL requirements. However, in rare cases, a permit would be reopened, upon approval of a TMDL to incorporate necessary requirements of the TMDL, when egregious impacts to the environment are observed or if the permittee is determined to be a significant contributor and there is obvious environmental impact that needs immediate attention. Per EPA guidance, the requirements that will be incorporated into storm water permits are in most cases, BMPs and not numeric effluent limits.

Each source/permit holder in a category will not be required to make the same reductions. Reductions will be determined on a facility-by-facility basis and, in most cases for storm water permit holders, reductions are required in the form of BMPs. EPA will give credit to facilities that are implementing BMPs at the time of permit re-issuance. BMPs will be required to be checked for effectiveness and if additional controls are needed, additional BMPs would be required upon permit reissuance.

Point source facilities that currently have no monitoring for certain TMDL parameters will not necessarily be considered to be a source. However, this will be determined as follows:

First, the facility may be asked to volunteer to monitor for that particular constituent in order to determine whether or not they are a source. Second, the permit may be modified upon reissuance to require monitoring for the constituent with no limit placed. Third the permit may be modified upon reissuance to require monitoring with a clause that if the parameter is detected at levels above the TMDL WLA then the facility must take measures to determine the particular source of the constituent and enact controls to reduce. Then if levels are not reduced the next permit may have limits. A fourth option, if a permittee refuses to take a voluntary sample, EPA can require sampling by issuing a 308 order.

7.2.5 Monitoring

The Department of Health maintains an ambient monitoring network that includes the Potomac and Anacostia Rivers and Rock Creek and tributaries. DOH will continue to compile data that become available.

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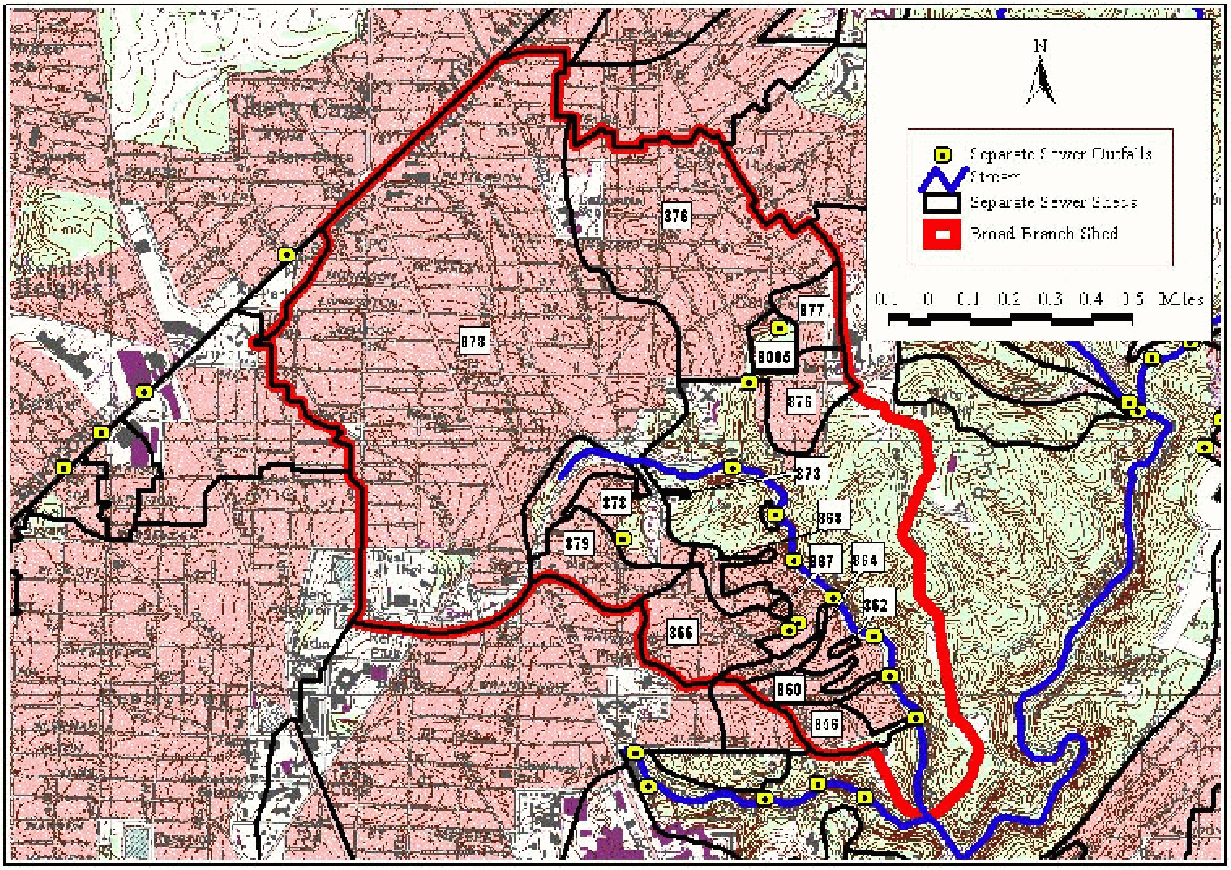
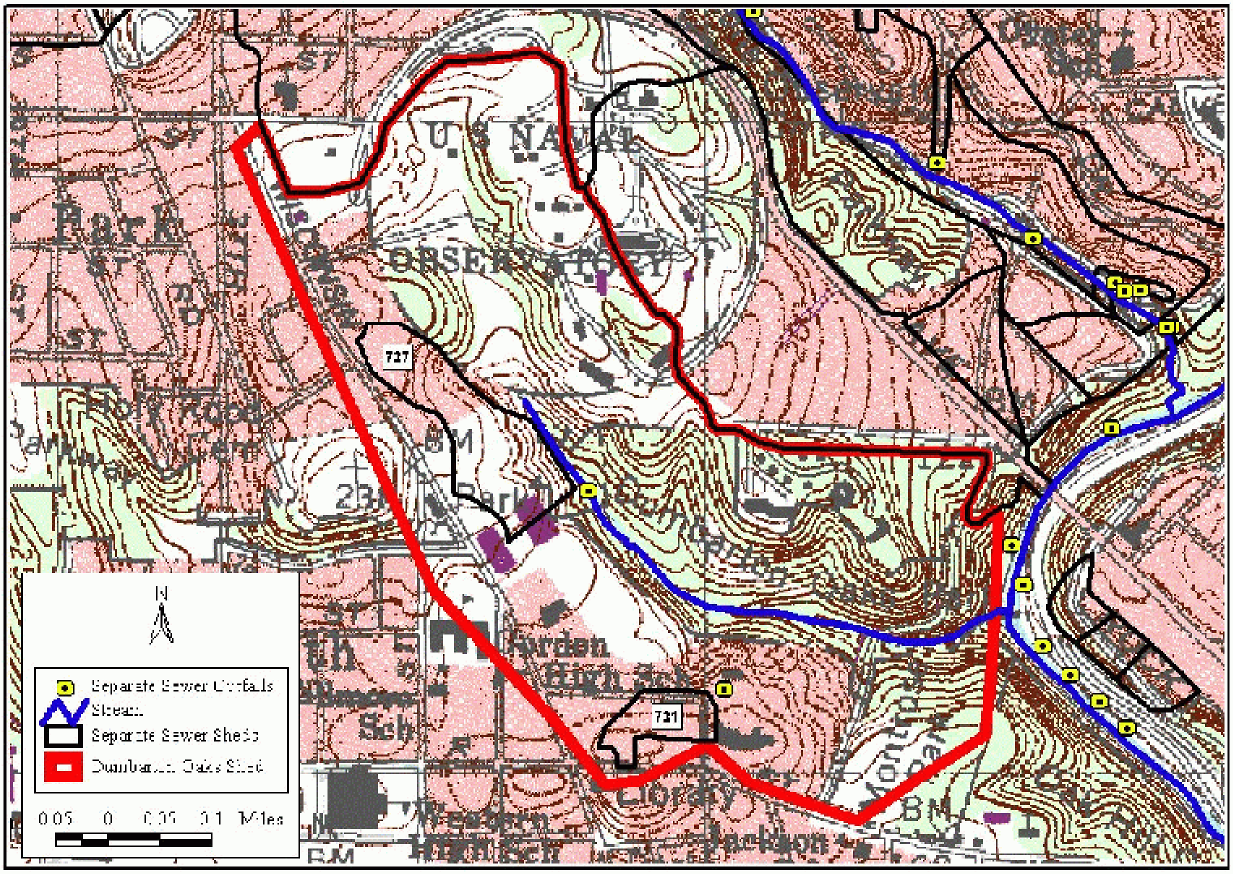
APPENDIX A

Maps of Rock Creek Small Tributaries

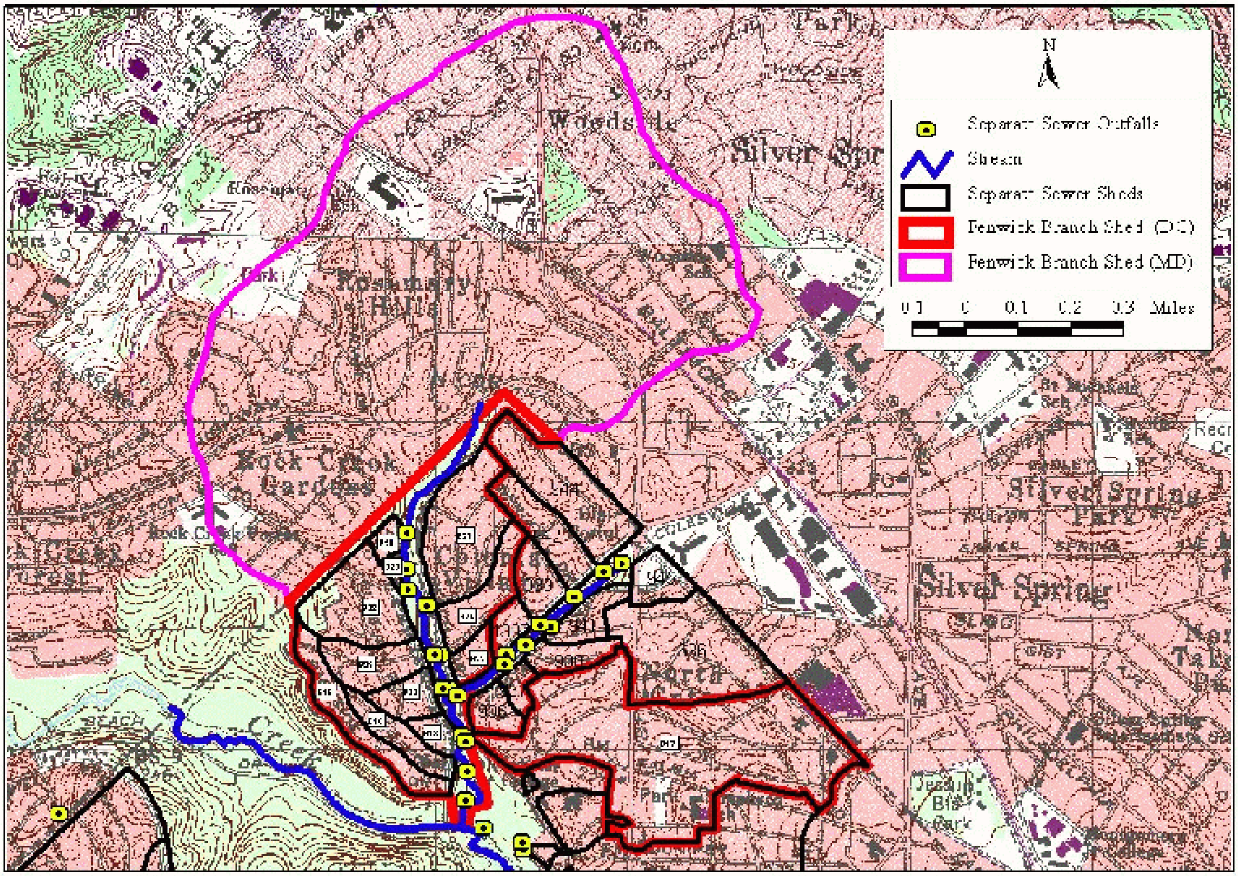
BROAD BRANCH



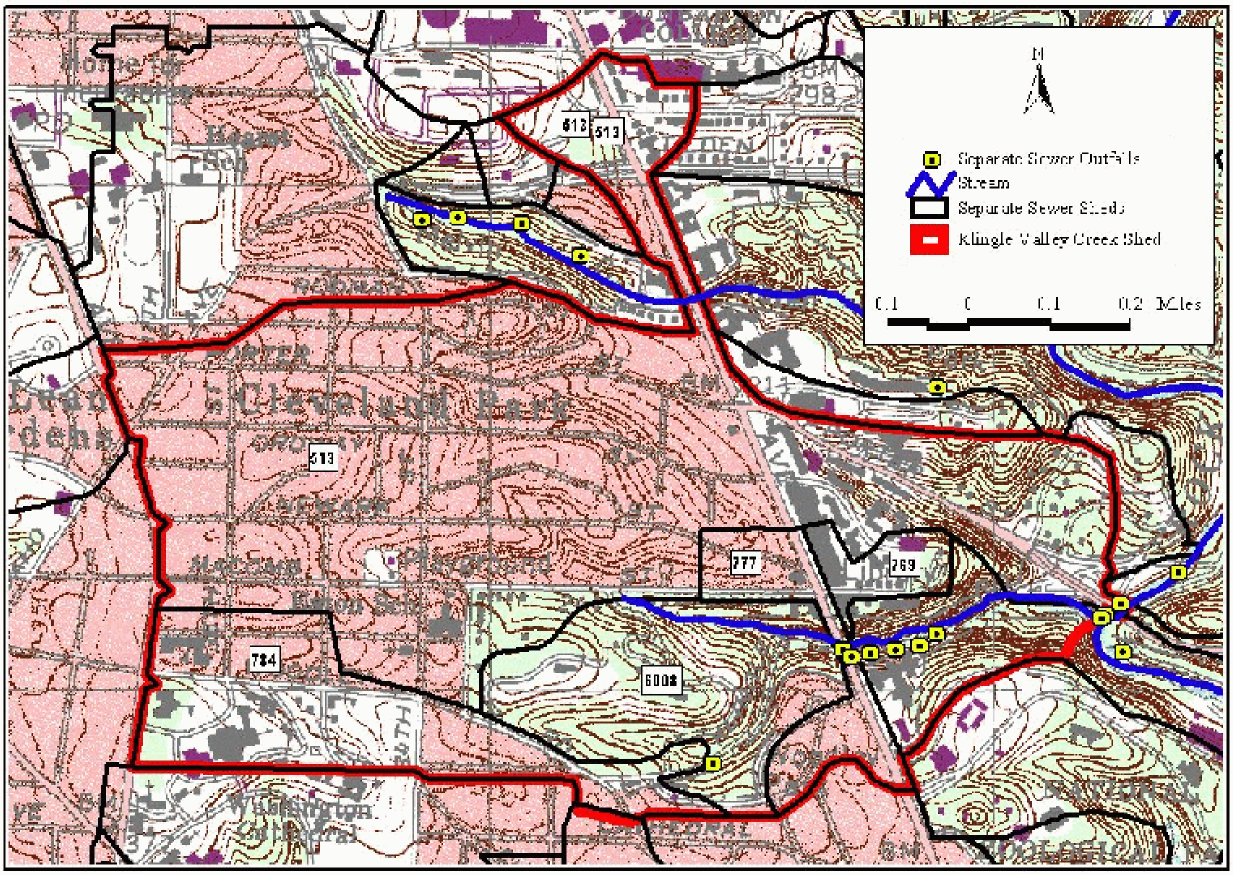
DUMBERTON OAKS



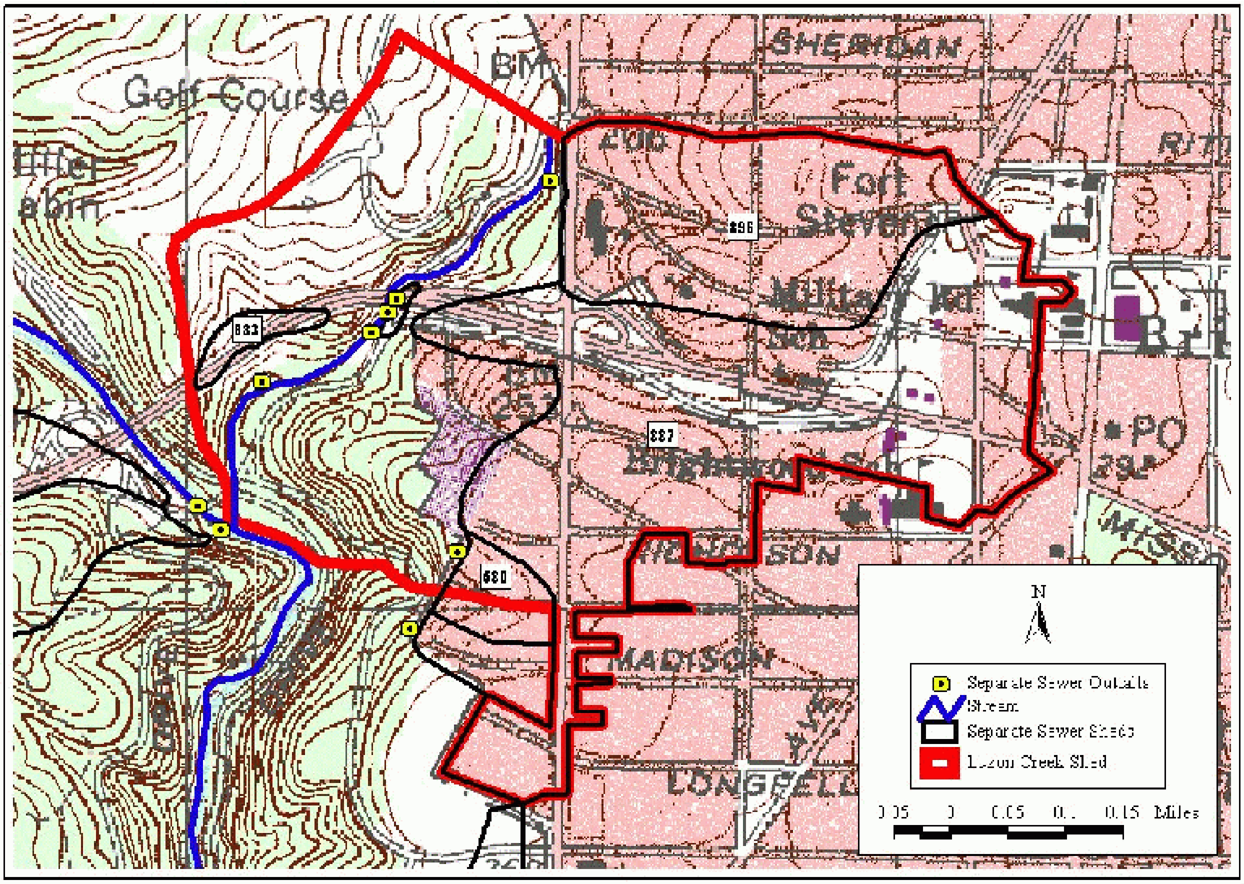
FENWICK BRANCH



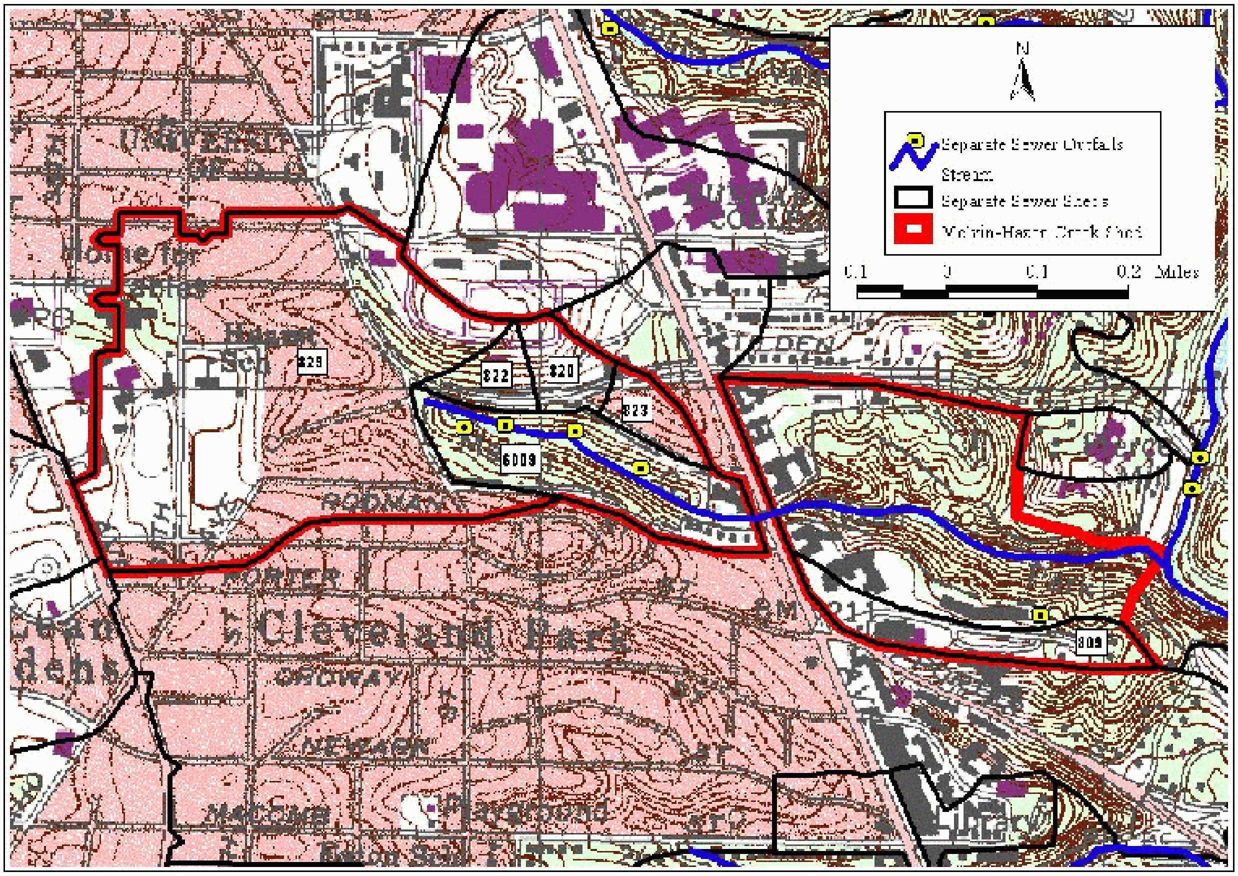
KLINGLE VALLEY CREEK



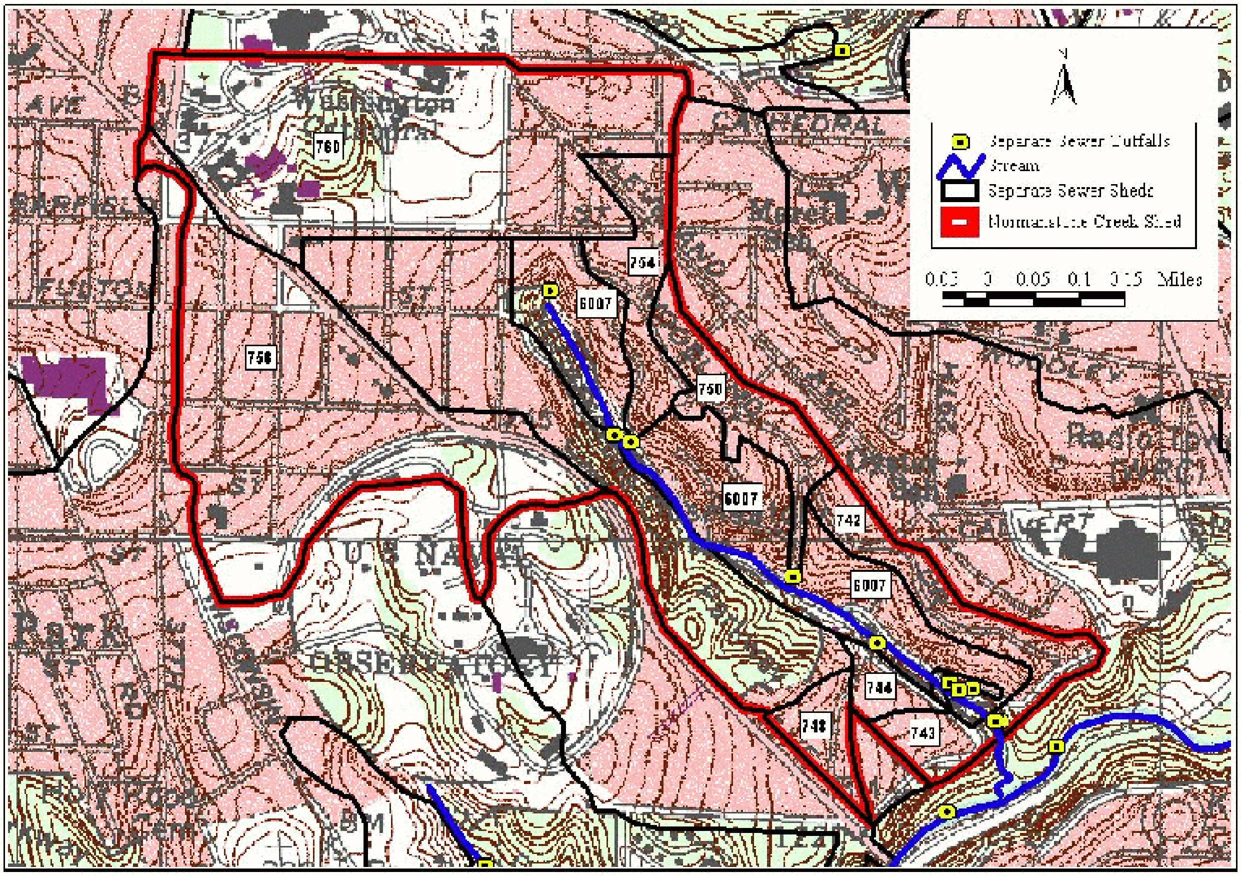
LUZON BRANCH



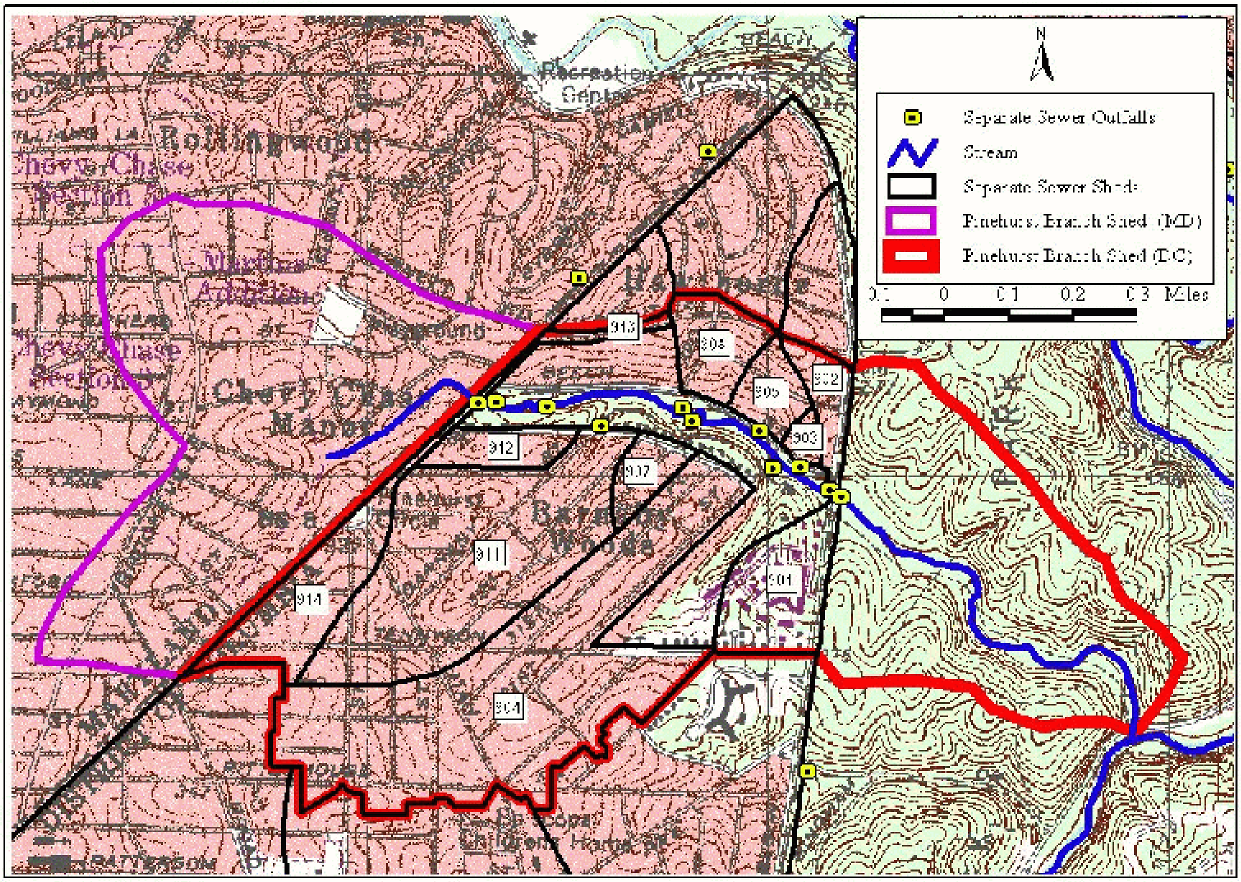
MELVIN HAZEN VALLEY BRANCH



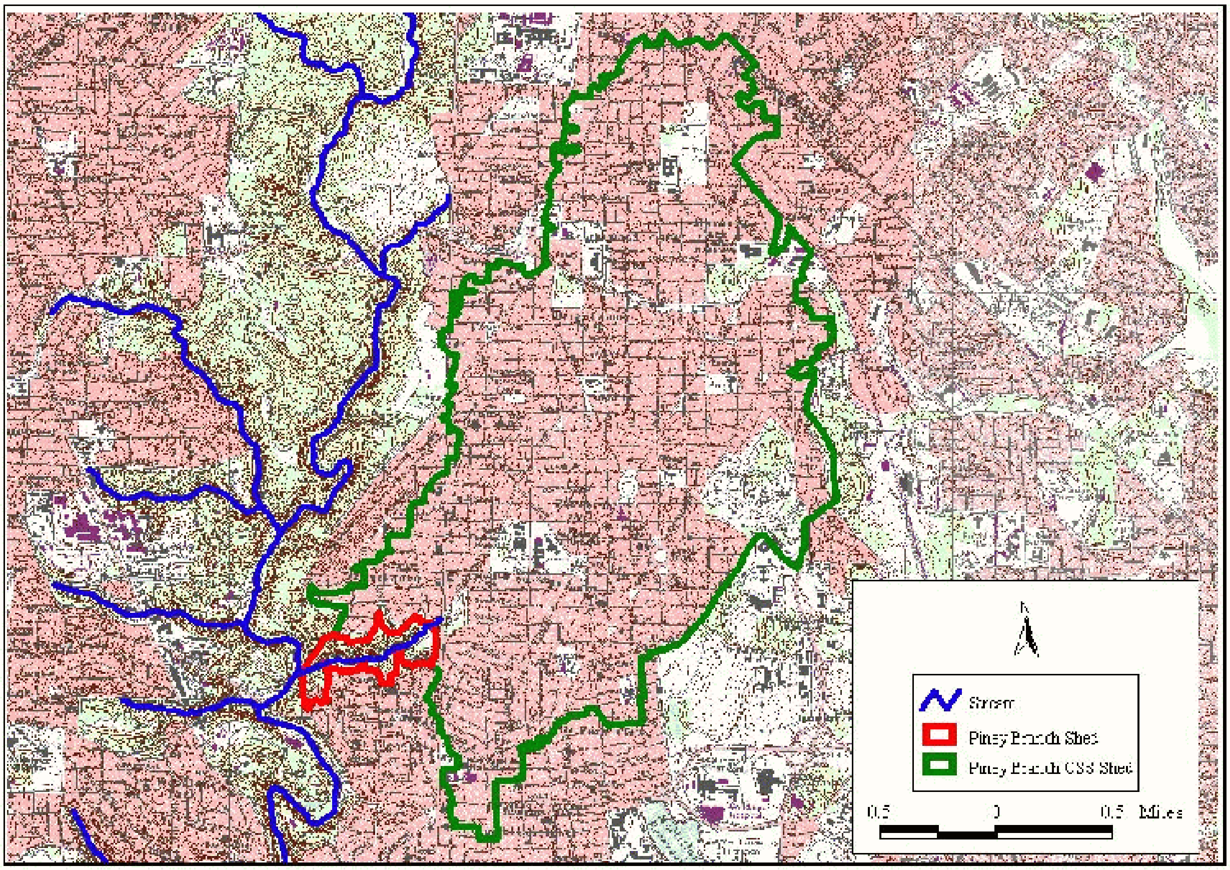
NORMANSTONE CREEK



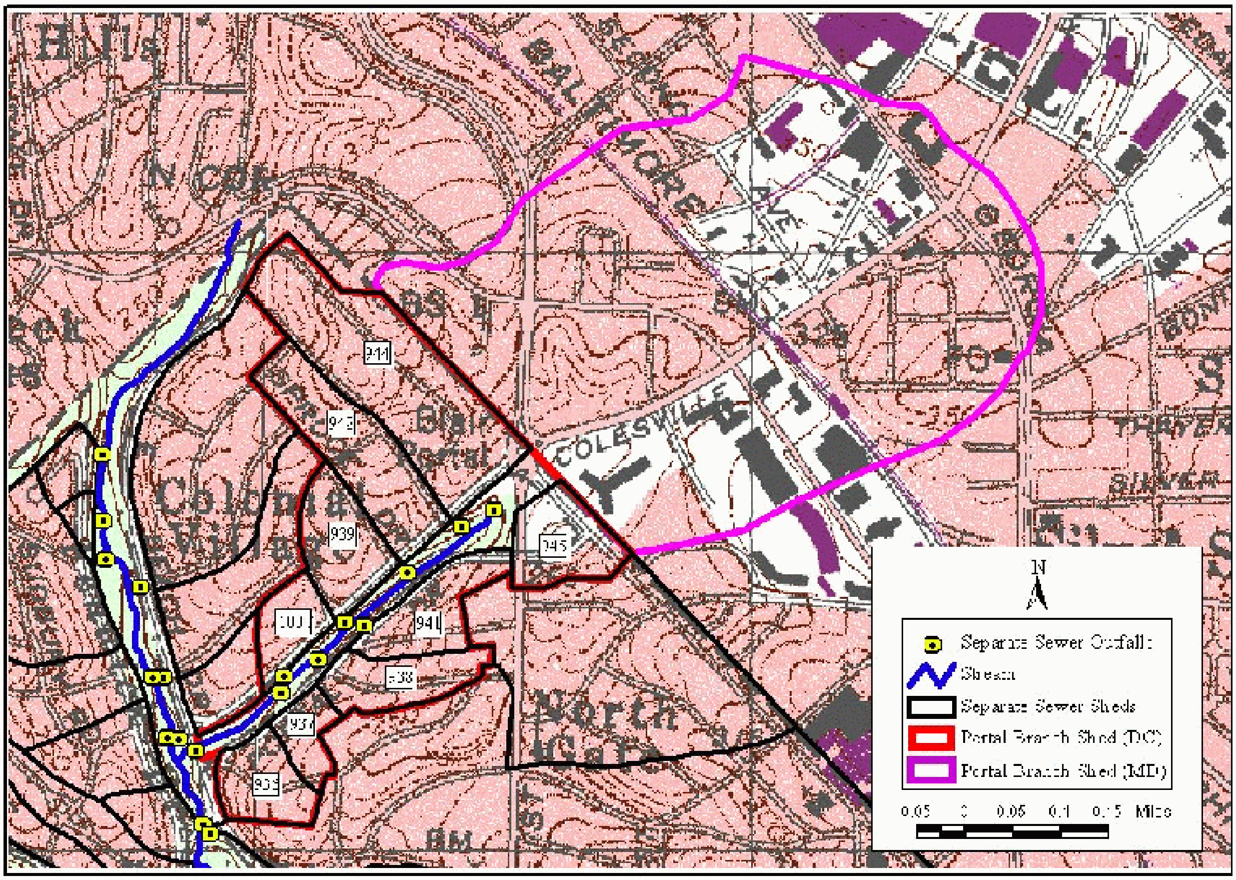
PINEHURST BRANCH



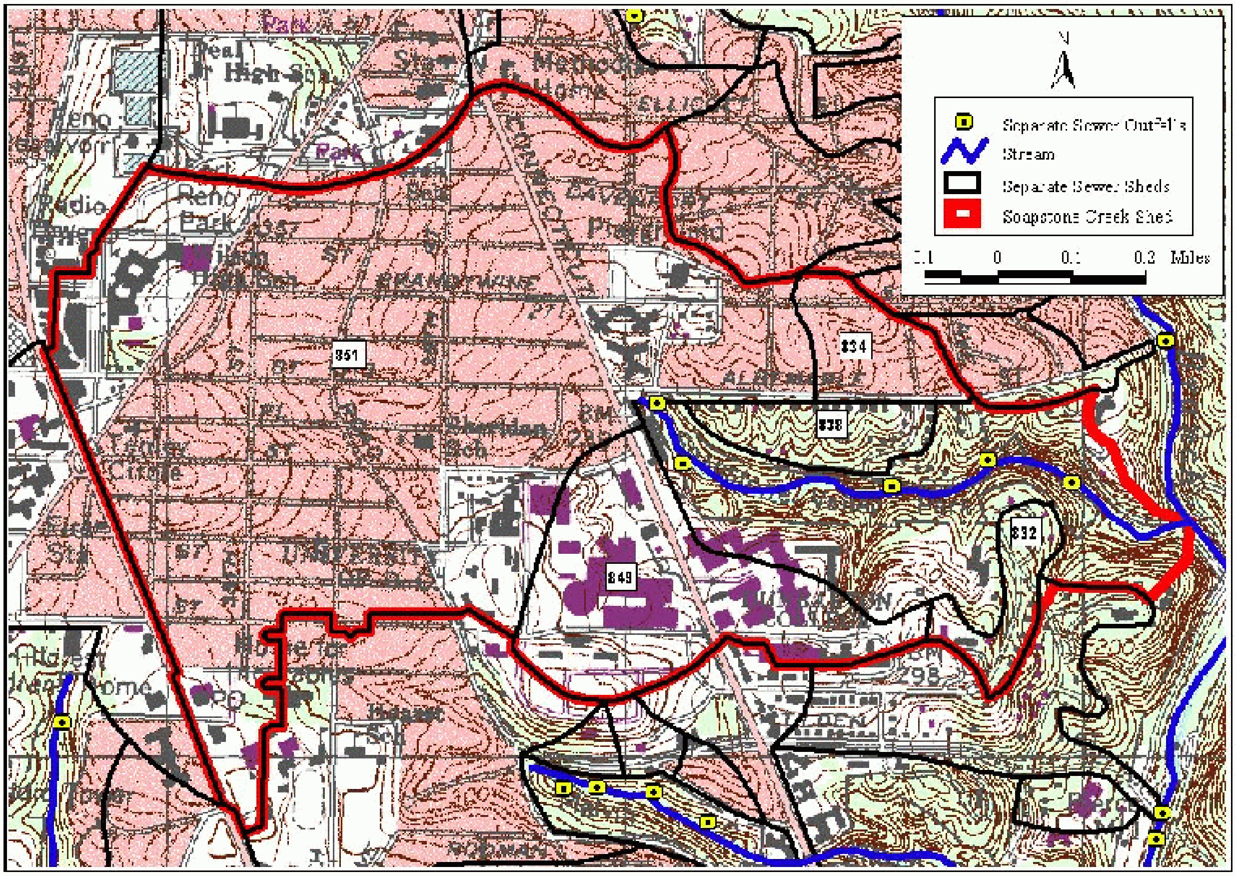
PINEY BRANCH



PORTAL BRANCH

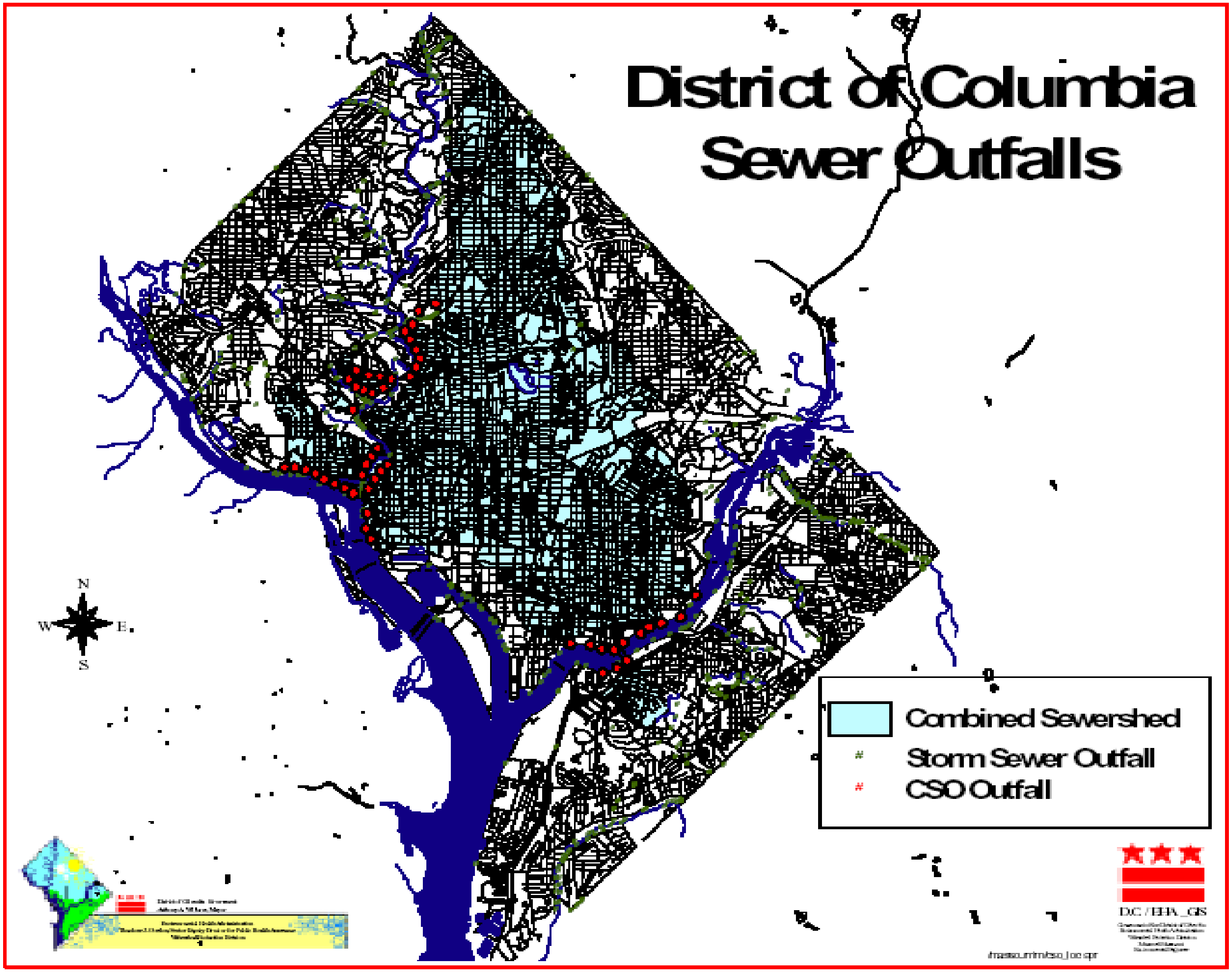


SOAPSTONE CREEK



APPENDIX B

Map of District of Columbia
Storm Sewer and CSO Outfalls



District of Columbia
Sewer Outfalls
N
W
E
S
Combined Sewershed
Storm Sewer Outfall
CSO Outfall
D.C. / EHA _GIS

APPENDIX C

DC Small Tributaries TMDL Model

The model, called the DC Small Tributaries TMDL Model developed by the Interstate Commission for the Potomac River (ICPRB), treats each tributary as a "bathtub" which, on each day of the simulation period, receives a volume of water representing storm water runoff and a volume of water representing base flow from groundwater infiltration, and completely mixes (ICPRB, 2003). The simple mass balance model predicts daily water column concentrations of constituents of concern in the tributaries. Instream processes, such as sediment resuspension or decay, are not simulated.

Daily estimates of baseflow and stormflow volumes for each tributary is based on ICPRB's Watts Branch HSPF model (Mandel and Schultz, 2000). Within the model, the storm runoff volume predicted by the HSPF model includes both separate storm sewer runoff as well as direct runoff flanking the tributaries. An HSPF model simulates hydrologic processes, such as infiltration, evapotranspiration, surface runoff, and ground water flow, from a watershed based on land use within the shed boundaries and on local precipitation and other climatic data. In this HSPF model, land use is divided into three land use categories: 1) impervious; 2) urban pervious; and 3) forested pervious. Because tributaries receive discharge from the District's separate sewer system, tributary sheds were not delineated based on topography alone but based on a combination of topographic information, information on the sewer outfalls discharging into the tributary, and engineering judgment.

The HSPF model was calibrated using stream flow data from the USGS gage on Watts Branch. The model was used for the Rock Creek tributaries under the assumption that these nearby urban sub-sheds have hydrologic properties similar to those of the Watts Branch sub-shed. Even there are some differences in hydrolgeological properties between Watts Branch and some of the Rock Creek tributaries, it is considered appropriate to use this model given the simplistic approach of modeling and the lack of data in Rock Creek tributaries. For Piney Branch, in addition to the base and storm flows from the HSPF model, flows from the combined sewer system (CSOs) was estimated using a sewer system model developed by D.C. Water and Sewer Authority and can be found elsewhere (DCWASA, 2002b).

The tributary model includes three sub-models, one of which is for organic pollutants and one for inorganic pollutants (metals). These two sub-models predict daily water column concentrations of each pollutant in each of the tributaries under current conditions and allow evaluating load reduction scenarios by simple percent reductions of base, storm and CSO loads.

Average concentrations for each constituent used as model input for base flow, storm flow and CSOs were based on available monitoring data from several studies and/or monitoring programs in the District, including data from the Northeast/Northwest Branches study, the DC MS4 monitoring program, and the DC WASA LTCP monitoring program, and described elsewhere in more details (ICPRB, 2003). Little toxics data exists for the tributaries, and what does exist relates primarily to metals. In cases were samples were analyzed for organics, the detection level was frequently higher than the water quality standards. The same average concentrations were used for all the tributaries in the model. The following tables present the average concentrations for organic-chemical and inorganic-chemical sub-models respectively.

Table A. Constituents of the DC Small Tributary Organic Chemicals Sub-Model

Constituent	Base Flow Conc. (µg/L, dissolved + particulate)	Storm Flow Conc. (µg/L, dissolved + particulate)	CSO Conc. (µg/L, dissolved + particulate)	Class C WQS - CCC (µg/L, dissolved + particulate)	Class C WQS - CMC (µg/L, dissolved + particulate)	Class D WQS (µg/L, dissolved + particulate)
Total Chlordane	0.000963	0.00983	0.00983	0.004	2.4	0.00059
4,4'-DDD	0.00462	0.003	0.003	0.001	1.1	0.00059
4,4'-DDE	0.00393	0.0133	0.0133	0.001	1.1	0.00059
4,4'-DDT (Watts Br only)	0.01226 (0.00061)	0.0342 (0.00171)	0.0342 (NA)	0.001	1.1	0.00059
Dieldrin	0.000641	0.00029	0.00029	0.0019	2.5	0.00014
Heptachlor Epoxide	0.000641	0.000957	0.000957	0.0038	0.52	0.00011
PAH1	0.0825	0.6585	0.6585	50	NA	14000
PAH2	0.219	4.1595	4.1595	400	NA	0.031
PAH3	0.1065	2.682	2.682	NA	NA	0.031
Total PCBs	0.0115	0.0806	0.0806	0.014	NA	0.000045

Table B. Constituents of the DC Small Tributary Inorganic Chemicals Sub-Model

Constituent	Baseflow Conc. (µg/L, dissolved + particulate)	Stormflow Conc. (µg/L, dissolved + particulate)	CSO Conc. (µg/L, dissolved + particulate)	Class C WQS - CCC [1] (µg/L, dissolved)	Class C WQS - CMC 1 (µg/L, dissolved)	Class D WQS (µg/L, dissolved)
Zinc	7.5	173	213	165.3	182.5	NA
Lead	0.6	29	80	6.2	159.2	NA
Copper	3.5	57	76	18.5	29.1	NA
Arsenic	0.2	1.4	1.4	150	340	0.14

[1] Zinc, lead, and copper values computed from the published District of Columbia standards assuming a hardness of 169 mg/L as CaCO3.

As noted earlier, the DC Small Tributaries TMDL Model uses the assumption that on each day of the simulation period a volume of base flow and a volume of storm flow water discharges into each tributary and completely mixes. The model was simulated using precipitation records for the three-year period of 1988 to 1990. For a given constituent, all tributary base flow volumes and storm flow volumes are assumed to have the estimated base flow concentrations and storm flow concentrations given in Tables A and B.

Model estimates of daily base flow and storm flow volumes discharging into each tributary are obtained as follows:

$$\text{BaseFlow} = \underset{\cdot}{V}_1 * (\text{PervArea} * \text{PerviousBase} + \text{ForPervArea} * \text{ForestBase}) \quad \textbf{(1)}$$

$$\text{StormFlow} = \underset{\cdot}{V}_1 * (\text{ImpArea} * \text{ImperviousStorm} + \text{PervArea} * \text{PerviousStorm} + \text{ForPervArea} * \text{ForestStorm}) \quad \textbf{(2)}$$

where

BaseFlow	= base flow entering tributary (m^3/sec)
StormFlow	= storm flow (separate storm sewer plus direct overland runoff) entering tributary (m^3/sec)
PerviousBase	= base flow per unit urban pervious area from Watts Br HSPF model (ac-in/ac-hr)
ForestBase	= base flow per unit forested area from Watts Br HSPF model (ac-in/ac-hr)
ImperviousStorm	= storm flow per unit impervious area from Watts Br HSPF model (ac-in/ac-hr)
PerviousStorm	= storm flow per unit urban pervious area from Watts Br HSPF model (ac-in/ac-hr)
ForestStorm	= storm flow per unit forested area from Watts Br HSPF model (ac-in/ac-hr)
PervArea	= urban pervious area of tributary sub-shed (ac)
ImpArea	= impervious area of tributary sub-shed (ac)
ForPervArea	= forested pervious area of tributary sub-shed (ac)
$\underset{\cdot}{V}_1$	= 0.02855 = conversion factor from (ac-in/hr) to (m^3/sec)

Daily constituent concentrations for each tributary with the exception of Piney Branch are then predicted using the following:

$$C = (\text{BaseFlow} * \text{BFConc} + \text{StormFlow} * \text{SFConc}) * \text{LoadMult} / (\text{BaseFlow} + \text{StormFlow}) \quad \textbf{(3)}$$

where

C	= model estimate of total constituent concentration (dissolved + particulate) in tributary
BFConc	= constituent baseflow concentration (dissolved + particulate)
SFConc	= constituent stormflow concentration (dissolved + particulate)
LoadMult	= load multiplier for simulating effect of potential load reduction scenarios

and where C, BFConc, and SFConc are in consistent units. For the Piney Branch tributary, the effect of loads from combined sewer system overflows (CSOs) is included. Daily volumes of CSO discharge to Piney Branch for the three-year time period, 1988-90 were obtained from DCWASA. Constituent concentration in Piney Branch were predicted using the following:

$$\begin{aligned} C = \; & (BaseFlow * BFConc * LoadMult \\ & + StormFlow * SFConc * LoadMult \\ & + CSOFlow * CSOConc * LoadMultCSO) \\ & / (BaseFlow + StormFlow + CSOFlow) \qquad \textbf{(4)} \end{aligned}$$

where

CSOConc	= constituent concentration in CSOs (dissolved + particulate)
CSOFlow	= CSO flow for Piney Branch in m^3/sec
LoadMultCSO	= load multiplier for evaluating effect of potential load reduction scenarios from the CSOs

Finally, the total daily load for each constituent for each tributary is calculated by

$$\begin{aligned} Load = \; & V_2 * (BaseFlow * BFConc * LoadMult \\ & + StormFlow * SFConc * LoadMult \\ & + CSOFlow * CSOConc * LoadMultCSO) \qquad \textbf{(5)} \end{aligned}$$

where

$$V_2 = 0.0864 = \text{conversion factor from (g/sec) to (kg/day)}$$

District of Columbia Water Quality Standards for the inorganic chemicals modeled in table B are given in terms of the dissolved fraction of these constituents. Therefore, in order to compare predictions of the inorganic chemicals sub-model with WQS, daily predictions for total zinc, lead, copper and arsenic are used to compute daily predictions for the dissolved fractions of these constituents using the assumption of instantaneous equilibrium partitioning, where the partitioning between the solid phase and the dissolved phase is assumed to be linear, that is,

$$C_s = K_d\, C_w \quad \textbf{(6)}$$

where the total constituent concentration is given by

$$C = C_w + C'_s \quad \textbf{(7)}$$

with

$$C'_s = C_s\, TSS \quad \textbf{(8)}$$

and

C_s = concentration of contaminant on solid phase (µg/g)
C'_s = concentration of contaminant on solid phase (µg/L)
C_w = concentration of contaminant in dissolved phase (µg/L)
TSS = concentration of total suspended solids (g/L)
K_d = partition coefficient (L/g)

Thus, combining equations (6), (7), and (8), the dissolved phase concentration, C_w, can be expressed in terms of the total concentration, C, as

$$C_w = C/(1 + TSS\, K_d) \quad \textbf{(9)}$$

Equation (9) is used in the DC Small Tributaries TMDL sub-model for inorganics to convert the model's daily predictions of total zinc, lead, copper, and arsenic concentrations to predictions of corresponding dissolved concentrations.

Because very little concentration data are available for the 23 tributaries with both dissolved and solid phase values, partition coefficients were taken from the District's TMDL model for toxics in the Anacostia River, the TAM/WASP Toxics Screening Level Model (Behm et al., 2003). Values for TSS in equation (9) are obtained from model predictions of daily TSS values using equations (1) through (4), and assuming base flow, storm flow, and CSO TSS concentrations of 0.002, 0.094, and 0.171 g/L, respectively, also taken from the TAM/WASP model.

K_d Values Used in the DC Small Tributaries TMDL Model

Constituent	**K_d (L/g)**
Zinc	420
Lead	400
Copper	94
Arsenic	100

The tributary model does a fair job in simulating daily concentrations of modeled constituents based on comparisons of model results with available data. In plots of predicted versus observed concentrations of zinc, lead, copper for Hickey Run and Watts Branch, the two streams for which the most data are available, model predictions fall reasonably close to observed values for the majority of the data points (ICPRB, 2003).

References

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DC WASA, 2002b, Study Memorandum LTCP- 5-4: Combined Sewer System Model Documentation, Washington, D.C.

ICPRB, 2003, District of Columbia Tributaries Total Maximum Daily Load Model – Final Report, prepared by Interstate Commission on the Potomac River Basin for DOH, Washington, D.C., June 2003.

Mandel, R., and C.L. Schultz. 2000. The TAM/WASP Model: A Modeling Framework for the Total Maximum Daily Load Allocation in the Tidal Anacostia River - Final Report. Prepared by the Interstate Commission on the Potomac River Basin for the District of Columbia, Department of Health, Environmental Health Administration. Washington, DC.

APPENDIX D

Rock Creek Tributary PCB Atmospheric Deposition and Allocated Load

Allocated PCB Load = Existing Load – Available Atmospheric Deposition Load

Existing PCB loads for the tributaries were determined using the DC Small Tributaries Model (See Appendix D). The calculations performed to determine the Total Available PCB Atmospheric Load to the Rock Creek Tributary Watersheds are described in the following:

Available atmospheric loads were determined using average annual atmospheric deposition flux in the Chesapeake Bay (Chesapeake Bay Program, 1999). The annual fluxes are:

Wet Urban Deposition = 8.3 ug/m2-year;
Dry Urban Deposition = 8.0 ug/m2-year; and
Total Wet-Dry Deposition = 16.3 ug/m^2-year

The PCB atmospheric loads for the Rock Creek tributary watersheds were calculated by multiplying the total wet-dry flux rate by the respective watershed area to generate total annual atmospheric loading. This result was then multiplied by the watershed runoff coefficient to determine the available atmospheric load for a watershed. Direct surface loading to a tributary is negligible compared to the watershed-based loading, hence, not specifically considered. For tributaries with watershed in both Maryland and the District of Columbia, available atmospheric loads were divided based on respective area ratios.

The runoff coefficient was determined by using the following formula:
Runoff Coefficient = 0.05 + .009 * (percent imperviousness)

Percent imperviousness values of the tributary watersheds are as follows (ICPRB, 2003):

Tributary	**Total Area (ac)**	**Impervious Area (ac)**	**Percent Imperviousness**
Broad Br	1129	281	24.9
Dumbarton Oaks	168	61	36.3
Fenwick Br	203	41	20.2
Klingle Valley	354	123	34.7
Luzon Br	648	217	33.5
Melvin-Hazen Br	184	61	33.2
Normanstone Cr	249	77	30.9
Pinehurst Br	443	78	17.6
Portal Br	73	15	20.5
Piney Br*	2500	837.5	33.5
Soapstone Cr	520	203	39.0

* Percent imperviousness for Piney Branch is considered the same as for Luzon Branch.

The PCB loadings for Rock Creek tributaries are as follows:

Waterbody	Drainage Areas Sq Miles	Drainage Area Sq.Meters	Total Atmospheric Load lbs/yr	Runoff Coefficient	Available Atmospheric Load (DC + MD) lbs/yr	Total MD Existing PCB Load	MD Land-Based Load	Total DC Existing PCB Load	DC Land-Based Load	TMDL (land-based source)
Broad Branch	1.764	4568901	0.1638	0.274	4.489E-02	0.000E+00	0	2.098E-01	1.649E-01	1.649E-04
Dumbarton Oaks	0.263	679872	0.0244	0.377	9.186E-03	0.000E+00	0	4.075E-02	3.157E-02	3.157E-05
Fenwick Branch	0.956	2476676	0.0888	0.232	2.058E-02	6.654E-02	5.285E-02	3.352E-02	2.662E-02	2.662E-05
Klingle Valley Creek	0.553	1432587	0.0514	0.363	1.863E-02	0.000E+00	0	8.266E-02	6.403E-02	6.403E-05
Luzon Branch	1.013	2622363	0.0940	0.351	3.304E-02	0.000E+00	0	1.476E-01	1.145E-01	1.145E-04
Melvin Hazen Valley Branch	0.288	744622	0.0267	0.348	9.302E-03	0.000E+00	0	4.177E-02	3.247E-02	3.247E-05
Normanstone Creek	0.389	1007667	0.0361	0.328	1.186E-02	0.000E+00	0	5.369E-02	4.183E-02	4.183E-05
Pinehurst Branch	0.967	2505004	0.0898	0.208	1.873E-02	2.781E-02	2.219E-02	6.524E-02	5.213E-02	5.213E-05
Piney Branch	3.906	10117141	0.3628	0.352	1.275E-01	0.000E+00	0	3.378E-02	0	0
Portal Branch	0.333	861980	0.0309	0.235	7.262E-03	2.239E-02	1.767E-02	1.217E-02	9.628E-03	9.628E-06
Soapstone Creek	0.813	2104365	0.0755	0.401	3.029E-02	0.000E+00	0	1.322E-01	1.019E-01	1.019E-04